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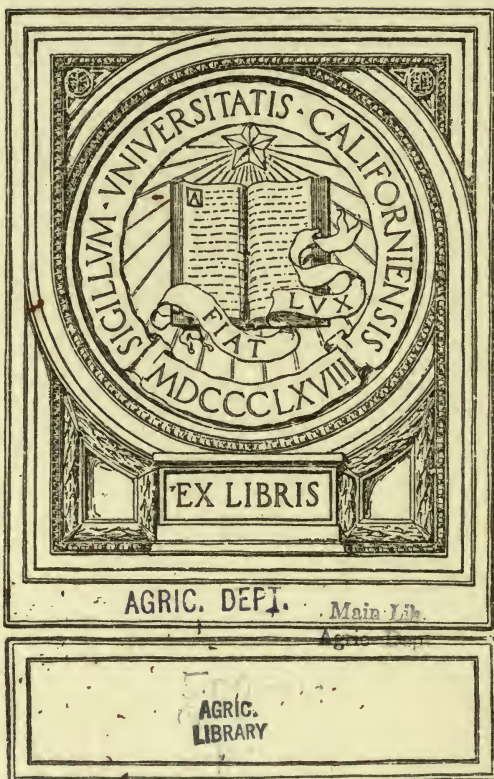
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# POTASH IN AGRICULTURE

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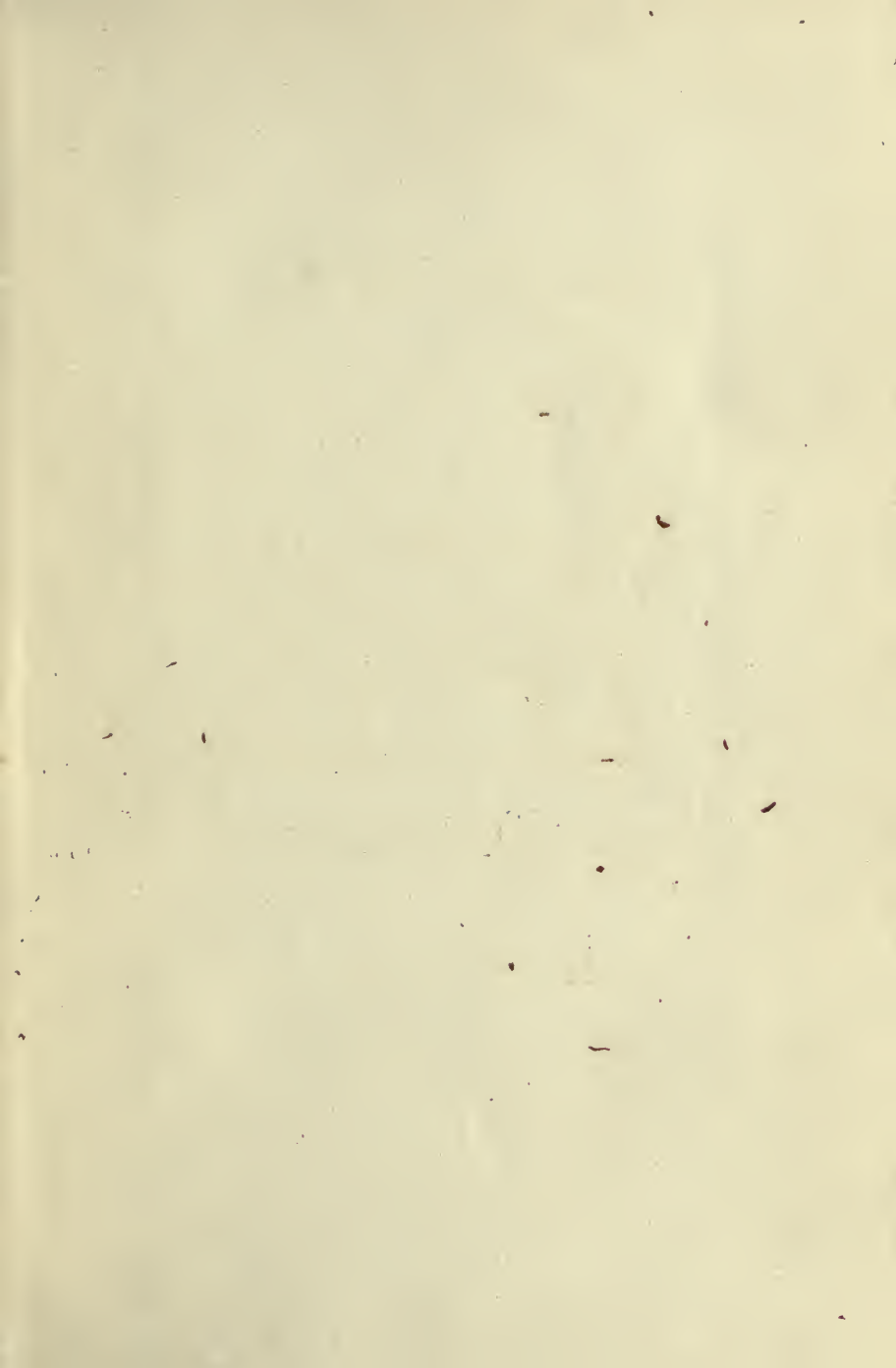


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POTASH

IN

AGRICULTURE

RESULTS OBTAINED IN  
THE UNITED STATES



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# POTASH

IN

# AGRICULTURE.

RESULTS OBTAINED IN THE  
UNITED STATES.

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## COMPOSITION OF POTASH SALTS.

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Agric. Dept.

NAME OF SALTS	GUARANTEED PER CENT OF ACTUAL POTASH
<b>A. Salts containing Chlorides:</b>	
Muriate of Potash.. . . . .	48
Manure Salt. . . . .	20
Kainit (crude salt) . . . . .	12
<b>B. Salts free of Chlorides:</b>	
Sulphate of Potash. . . . .	47
Sulphate of Potash-Magnesia. . . . .	25



## PREFACE.

---

It has been found necessary to issue another edition of the pamphlet, "POTASH IN AGRICULTURE." The present edition contains all the good points of the former one, together with many new and valuable additions, which bring the subject down to date.

One feature of this pamphlet is the careful collection of extracts from the official reports and bulletins of the Experiment Stations of the United States. The practical value of the results obtained by the Stations in field experiments with fertilizers, reported herein, cannot be overestimated. The farmers of the various States, whose soils have been exhausted by continuous croppings, now realize the necessity of a liberal supply of Potash on their lands for the wants of their crops, as a result of information obtained through these experiments.

The Station investigations and the experiences of practical farmers all show that most commercial fertilizers have been and are yet, to some extent, not entirely adapted to the production of the highest yields and of the best quality of crops. The reason for this is, that some of these old-style commercial fertilizers contain an insufficient amount of potash. The old brands of fertilizers rarely contained more than 2 or 3 per cent. of potash. Nowadays, some of the leading fertilizer manufacturers advertise and sell brands of fertilizer which contain 10 per cent. of actual potash. It is a favorable sign, that such fertilizers are becoming more common on the market.

In addition, there is a brief account of the general principles of potash fertilization, which will no doubt prove valuable to farmers.

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## THE STASSFURT INDUSTRY.

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Early in the last century, Stassfurt, in Northern Germany (in the province of Saxony), was noted for its extensive salt-works, which employed on y the unscientific pan process of evaporating water from a natural brine, obtained by pumping from driven salt-wells. This method was slow, wasteful and expensive, so that when deposits of solid rock-salt were discovered in various places, this evaporated product could not compete against the mined crystal salt.

Thus, the Stassfurt Works ceased to yield their former large revenue to the Prussian Government. In fact, owing to the condition of the salt market, these works became dead property, and with the hope of turning them to some profit, the Prussian Government began borings for rock salt in 1839. A shaft was sunk (begun in 1852) and in 1857, at a depth of 1080 feet, a stratum of rock salt was discovered, after having drilled through a deposit of so-called "Abraumsalze" (refuse salts), consisting largely of potash and magnesia compounds, which were then considered worthless, but now are known to be of inestimable value to the agricultural and the manufacturing world.

Up to that time wood ashes were the only source of potash, and, as their supply was limited and decreasing in quantity, they could scarcely supply the demands of the chemical industries. Then came the patient and skilled researches and startling discoveries of that great scientist Liebig. By him and his influence the secrets of plant-food and plant-growth became known, and it was discovered that potash was one of the ingredients, important and necessary to the sustenance of plant-life.

In the light of these discoveries, the vast potash deposits at Stassfurt forthwith attracted attention, and mining for these salts was presently begun. Soon both the crude salts and the refined articles in various forms were put upon the market and placed within the reach of the cultivator.

The success of potash fertilization, in increasing yields and improving the quality of fruits, grains and forage, soon created an enormous demand for the Stassfurt Potash Salts—a demand which has



increased from year to year and made Stassfurt again the centre of vast commercial and manufacturing industries. To-day it employs in round numbers 30,000 laborers, not to mention chemists, engineers, superintendents, clerks, and the like, and the large number elsewhere now engaged in handling its products.

From small beginnings and through varying fortunes this once quaint little town has become a great industrial centre, from which hundreds of thousands of tons of Potash Salts are annually shipped, carrying hundreds of thousands of tons of agricultural fertility to all the civilized lands of the world. Sixty odd large Potash mining establishments supply crude material, and the large chemical works at Stassfurt and vicinity produce an enormous output of Potash products. These establishments are commercially united under the name of

### THE GERMAN KALI WORKS.

## PART I.

---

### THE WAY TO USE POTASH.

---

As one object of this pamphlet is to describe the results obtained from potash salts upon various crops, some account of their use and method of applying them may be given. The better the farmer understands the principles of potash fertilization the better will be his results. Therefore, the following important suggestions are offered:

#### **1. PHOSPHORIC ACID AND NITROGEN, AS WELL AS POTASH ARE ESSENTIAL TO PLANT GROWTH.**

The three substances required to be given to plants to sustain their life and to induce a healthy and vigorous growth are: Potash, Phosphoric Acid and Nitrogen; and sometimes lime is needed. All three substances have their part to perform, and *neither one can take the place of the other*. Thus, fertilization with potash alone does not pay, except in rare instances, and so with the other substances when used by themselves.

#### **2. SOILS AS WELL AS PLANTS DIFFER IN THEIR NEEDS FOR POTASH.**

As every experienced farmer knows, some soils contain more of one kind of plant-food than of another. The great advantage is in finding out just what the soil lacks in the way of plant-food, and what form and what quantity of fertilizers should be supplied to make up the deficiency.

It would be easy to compound a fertilizer suited for certain crops, if all soils contained the elements of fertility—that is, potash, phosphoric acid and nitrogen—in the same quantity and in the same form, but these conditions are seldom found on any farm; hence the practical farmer must study the conditions of his soil and compound his fertilizer in such a way as to raise the largest crops at the lowest cost.

#### **3. LEGUMINOUS PLANTS DRAW NITROGEN FROM THE AIR.**

The leguminous plants are such as beans, peas, clover and vetches. The characteristic of these plants is that they draw nitrogen from the



air sufficient for their wants; hence, they should be supplied with those other ingredients which are necessary to plant-growth. This explains why potash has proven most useful when applied to all kinds of legumes. It stimulates and increases their power to obtain nitrogen, which latter is the most expensive material the farmer has to buy, and which is returned into the soil at a very slight cost when leguminous plants are plowed under. This is called "green manuring."

#### **4. HOW GREEN MANURING BRINGS PROFIT.**

The heavy expense which heretofore attended the use of nitrogenous fertilizers can be decreased to a large extent by green manuring. By raising the leguminous crops in rotation, the roots, leaves and stalks decay in the soil and furnish a large quantity of free nitrogen for succeeding crops. Besides, humus is added to the soil, thus improving its chemical and physical condition. Green manuring is now regarded as the best and cheapest method of restoring fertility to worn-out soils. But leguminous crops, such as clover, beans, peas or vetches, can only do their best if they are well fertilized with potash and phosphoric acid.

#### **5. LIME IS NECESSARY UPON SOME SOILS AND FOR SOME PLANTS.**

There is usually lime in sufficient quantity in most soils for the requirements of plant-food only, but sometimes the farmer must supply lime for the purpose of improving the mechanical condition of the soil, especially to such soils as are too stiff, and to sandy soils. Soils of a peaty nature are also much improved by the use of lime. Lime is also the best means of sweetening sour soils and thus making them productive.

#### **6. APPLY POTASH SALTS EARLY AND AVOID TOP-DRESSING.**

The time and method of using potash are important. In many cases positive damage is done by applying fertilizers too late in the season. The full effect of the potash and also of phosphoric acid is obtained only when these mineral fertilizers are applied some time previous to planting, or sowing of the crop. The farmer should not make the mistake of applying potash salts as a top-dressing. The proper way is to plow them under, so that the food will be readily taken up by the tiny rootlets of the growing plants.

What has been said about potash and phosphoric acid does not apply to nitrogenous fertilizers, especially in the form of nitrate of soda. Nitrate of soda, sulphate of ammonia and like fertilizers are more quickly and easily washed out of the soil and lost than any other manure. Therefore such fertilizers should be applied as a top-dressing to crops in the spring, and not in the fall and winter, and in many cases they can be applied with advantage during the growing season.

#### **7. THE PLACE OF MAGNESIA.**

This element, which is deficient in some soils, is often needed in plant-growth and plant-life. The potash salts containing a large percentage of magnesia are kainit and sulphate of potash magnesia. These materials may be supplied with good results, especially upon very sandy soils, and also upon peaty soils. The magnesia in kainit has another valuable quality, as it is very effective and extensively used for the purpose of destroying insects, pests and fungi (grub-worms, root-lice, etc.) present in the soil.

#### **8. THE EFFECT OF CHLORINE.**

The Potash salts containing chlorine are kainit, muriate of potash and Potash manure salt. The sulphate of potash and sulphate of potash magnesia are free from chlorine. Where quality of some fruits and some crops is to be considered, and where direct application is to be made, it is best to use the sulphate of potash or sulphate of potash magnesia, instead of the muriate or kainit. This applies to tobacco, perhaps oranges, and some other fruit and vegetable crops. It is easy, however, to avoid the objectionable effect of muriate of potash or kainit by applying the fertilizer several months previous to planting, or better still to the preceding crop.

When land inclines to sourness Sulphate of Potash has been found more economical than the Muriate, notwithstanding the somewhat higher price per ton of the former. This is because the Sulphate does not have a tendency to exhaust the lime of the soil as does Muriate. A saving will be effected on such soils through the use of Sulphate of Potash.

#### **9. THOROUGH CULTIVATION IS ESSENTIAL TO SUCCESS WITH FERTILIZERS.**

A plant can only do its best when all the elements upon which it feeds are presented to it under the most favorable conditions. For if, by neglect of proper cultivation, the soil becomes hard, it offers re-



sistance to the growth of the roots, and can neither absorb nor retain the moisture necessary to plant-growth; under such conditions artificial fertilizers cannot show their full benefit. To the objection sometimes made that artificial fertilizers stimulate the growth of weeds, it is only necessary to remark that the weed, as a robber, revels in a certain soil, and that whatever promotes the growth of the weed will also furnish the elements of strength to the crop planted and will make the latter profitable to the planter.

The object of cultivation is to bring the soil into that condition which is best suited for the growth of the plants. Thus, it prepares the way for the different kinds of plant-foods; namely, nitrogen, phosphoric acid and potash, which are applied in the fertilizer.

#### **10. POTASH SALTS AS MANURE PRESERVER.**

All kinds of animal manure when exposed to the elements lose a considerable part of their organic matter and nitrogen by decomposition. This loss which amounts to about 25 per cent. or more of the nitrogen, can largely be prevented by the use of kainit, which has the property of absorbing and retaining nitrogen and preventing a harmful fermentation, which latter causes a loss of organic matter. When using kainit for this purpose, sprinkle daily in the stable,  $1\frac{1}{2}$  to 2 lbs. for every full-grown animal being a fair average. By this procedure, not only a large amount of organic matter and valuable nitrogen is retained, but the manure produced is also enriched by potash.

#### **11. POTASH SALTS AS INSECTICIDES AND FUNGICIDES.**

Few plants escape the attacks of insect enemies; or are free from some disease. Plant lice, scales, cabbage maggots, onion maggots, wire-worms, cut-worms, and other insects do an incalculable amount of damage every season. Many of these feed upon the roots of plants deep in the soil, where they cannot be reached by the usual remedies applied through a spraying apparatus. The way to destroy these pests is to put a large quantity of kainit in the soil. This contains magnesia, which seems to be an effective destroyer of these insects. The same remedy has also been employed with much success to cure cotton-root rot and cotton-blight, and shelling of the grape. Practical farmers in various sections of the country have noted the invigorating and restorative effect of potash salts upon sickly crops, and upon fruit trees and vines suffering from diseases.

## 12. WOOD ASHES AND TOBACCO STEMS AS POTASH FERTILIZERS.

The above materials are used as fertilizers mainly because the potash, which they contain, makes them valuable. The trouble is, however, that the amount of potash is not a uniform quantity. Thus, wood-ashes that were supposed to contain 5 per cent. of pure potash, are frequently found to have not more than 2 or 3 per cent. This difference in the potash value cannot be detected by the appearance of wood ashes. The potash in tobacco stems ranges from 4 to 9 per cent. It follows, therefore, that the farmer should insist upon a guaranteed chemical analysis in these substances, and should calculate the market price of potash per pound contained in his wood-ashes and like fertilizers before purchasing.

The following matter treats of the qualities of the three principal fertilizing substances—potash, phosphoric acid and nitrogen—which have been found useful upon many soils, and may be taken as a guide in the fertilization of soils in which the manurial requirements have not been ascertained:

## GRAIN CROPS.

All the grain crops (wheat, oats, rye and barley) remove from the soil large quantities of nitrogen, phosphoric acid and potash. The experiences of the most successful farmers show that the cereals should have a proper place in the rotation of crops on the farm. Thus, wheat comes in very well after a crop of Indian corn; barley after a well-manured crop of potatoes or Indian corn.

By green manuring—that is, by “plowing under” a crop of clover, peas or other plants which draw their nitrogen from the air—the economical farmer is able to obtain sufficient nitrogen to produce a good grain crop, if a liberal supply of potash and phosphoric acid be given to the soil. A light top-dressing of 40 to 50 lbs. per acre of nitrate of soda may be profitably applied to wheat and oats in the spring, even when they follow a nitrogen gathering crop. If grain crops do not follow a nitrogen-gathering crop, a larger quantity of nitrogenous fertilizer is needed; 200 to 300 lbs. of nitrate of soda per acre are suitable quantities, and it is well to apply this in doses, one-fourth (50 lbs.) in autumn at the time of planting, half the remainder (75 lbs.) in the spring, and the balance (75 lbs.) just before the blossoms appear. In spring-planted grain crops, half of the nitrate of soda should be given at the time of sowing, and the rest at the time of stooling.



In addition to the nitrogen, it is essential to apply the proper quantities of potash and phosphoric acid to grain crops, and a neglect in this respect will not only prevent a remunerative yield, but will also cause the grain to lodge.

The following quantities per acre may be taken as an average for cereal crops:

500 lbs. per acre of a fertilizer containing 8 per cent. of phosphoric acid and 5 per cent. potash. As many practical farmers have found that barley responds well to potash fertilizers, a larger amount of potash than above recommended may often be applied with profit.

---

## CORN.

The importance of potash fertilization for corn is established beyond question by the results obtained at the Experiment Stations of a great number of States. These results show that the marked increase in the yield of corn and fodder is due to potash, which is the controlling element, rather than to phosphoric acid or nitrogen. If a legume crop as clover or alfalfa precedes the corn, there is little need of nitrogen beyond that supplied by green manuring, while phosphoric acid may be used in smaller doses than potash.

The attention of practical farmers is called to the results with potash upon corn crops at the Kentucky, Massachusetts, Connecticut, New Hampshire and New Jersey Experiment Stations. Here we have experiments in different States upon different soils, and the results of potash fertilization on the yield of corn and fodder show for themselves. In the Kentucky blue-grass region the increase was from 30 to 50 bushels of ear corn per acre.

On peat soils which are rich in nitrogen and phosphoric acid an increase of 30 bushels and more of shelled corn has been obtained by using 200 lbs. per acre of Muriate of Potash.

---

## COTTON.

The uplands of the South are usually in a poor state, owing to the old-time practice of planting the same lands year after year with cotton. Hence, the first thing is to improve the physical and mechanical condition of the soil. This can be done most economically by "plowing under" green crops, such as a crimson clover or cow-peas, in combination with potash-phosphate fertilization.



The importance of green-manuring in cotton culture has been established by Station experiments and by practical planters. The "plowing under" of leguminous crops not only improves the mechanical condition of the soil, but at the same time adds a large amount of nitrogen, thus making the expense of artificial fertilizers considerably less. The cultivation of crimson clover and cow-peas is rapidly spreading in the cotton belts of the South. It has been found a profitable practice to sow among the cotton plants at last cultivation 15 lbs. per acre of crimson clover seed. This does not interfere with the maturing of cotton, while it prevents the land from leaching during heavy winter rains, besides preserving and retaining valuable nitrogen in the soil. In order that crops of crimson clover and cow-peas may grow vigorously, and to obtain an abundant supply of nitrogen, it is necessary that they be properly supplied with potash and phosphoric acid.

The attention of cotton planters is called to the results obtained with potash upon cotton crops at the Alabama, Mississippi, and South Carolina Experiment Stations. In South Carolina 500 to 1000 lbs. of a fertilizer containing 4 per cent. nitrogen, 10 per cent. phosphoric acid and 4 per cent. potash produced good results upon clay soil, and upon a sandy soil in the East. The same quantities are found profitable in North Carolina and Georgia.

In some sections the planters suffer heavy losses from leaf-blight of cotton. Prof. Atkinson's experiments on the Experiment Station farms in Alabama show that, by the use of kainit (400 lbs. per acre) leaf-blight is largely, if not entirely, prevented, and the yield of cotton increased. The use of kainit for this purpose is now becoming the recognized remedy, and cotton planters will find it invaluable.

---

## POTATOES.

There is no doubt about the need of potash for a good potato crop. The presence or the absence of potash will determine the yield of tubers.

A few words as to the effect of the different forms of potash salts: Sulphate of potash or sulphate of potash magnesia always produces a good quality of potatoes, while the salts containing chlorine, that is, kainit and muriate of potash, may lessen the amount of starch and thereby produce potatoes of inferior quality.

It should be pointed out that injury can be avoided in two ways: First, by using sulphate of potash or sulphate of potash magnesia; second, by spreading the muriate or kainit broadcast in autumn, so that by spring the chlorine will have washed into the subsoil.

Equally favorable are the results of the use of potash on sweet potatoes. Attention is called to the experiments with sweet potatoes at the Delaware and New Jersey Stations and at Southern Pines, N. C. It does not appear that the form of potash salts had an injurious effect on the quality of the sweet potatoes.

The following may be taken as a good average potato fertilizer: 7 per cent. phosphoric acid, 3 per cent. nitrogen and 10 to 12 per cent. potash, used at the rate of about 700 lbs. per acre.

---

## TOMATOES.

Although tomatoes are a garden crop, they are grown on a large scale for market and for canning. The chemical composition of the tomato shows large quantities of nitrogen and potash, indicating that these elements are much needed. This is verified in practice, and the beneficial effects of nitrogen and potash will be seen from the results of careful experiments at the Delaware and Maryland Stations. Another effect is to hasten the ripening of the fruit, while the potash gives fine color and quality.

The following is recommended for tomatoes: About 500 lbs. per acre of a fertilizer containing 7 per cent. phosphoric acid and 10 per cent. potash. In addition about 250 lbs. of nitrate of soda, half applied as top-dressing previous to planting and the other half just before fruit begins to set.

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## TOBACCO.

As the tobacco crop exhausts about 103 lbs. of potash per acre, this loss must be made good by a fertilizer rich in potash. What has been said about applying potash salts to the potato, applies with even more force to the tobacco plant. In order to have a leaf that has a fine flavor and burns well, it is best to use sulphate of potash, and to avoid using the forms of potash salts containing chlorine, such as kainit and muriate of potash. Stable manure should not be applied directly to the plant, but to the preceding crop. Rank organic manures, tankage, fish scraps, etc., should not be used.

A good average tobacco fertilizer should contain about 7 per cent. of available phosphoric acid,  $3\frac{1}{2}$  per cent. nitrogen, and 10 per cent. of potash. The potash should be in the form of sulphate. Fertilizers which contain chlorine should be avoided.

## GARDEN CROPS AND VEGETABLES.

The various forms of potash salts are indispensable to profitable gardening. The kind and amount of potash needed will always depend upon the requirements of the soil and of the different crops. One or two suggestions may be made.

For asparagus large quantities of kainit are essential for rapid growth and large stalks. Some growers find that not less than 1,000 lbs. or even one ton, of kainit per acre, together with 250 lbs. or more of nitrate of soda will give them the best results.

For celery, experience has shown that a fertilizer containing about 8 per cent. potash is necessary in order to obtain good yields. As this crop is often grown on muck or swamp land, which is usually deficient in potash, this element of plant-food should be liberally supplied in the fertilizer, while nitrogen is not needed as a rule on such soils.

For cucumbers a liberal supply of potash and phosphoric acid is essential to a good crop. The tendency of a heavy application of nitrogenous manures is to produce a hollow fruit of poor keeping quality.

---

## FRUITS AND BERRIES.

Practical and successful fruit-growers are finding out every year the importance of potash fertilization, and especially those who have trees on a sandy soil find that they cannot get fruit of the finest quality without it.

The nitrogen should be applied to orchards by plowing under a crop of crimson clover, cow-peas, beans, etc. It is the same with the vinyard. The nitrogen obtained by green manuring is usually sufficient to produce a good growth of wood, while potash and phosphoric acid are needed to develop and ripen fine quality of fruit. Nitrogenous fertilizers are used where green manuring cannot be practiced, as, for example, in strawberry culture.

The following quantities per acre may be taken as an average application for fruit: 1,000 lbs. per acre of a fertilizer containing 8 per cent. phosphoric acid 10 per cent. potash, (and 3 per cent. of nitrogen where needed.)



## PART II.

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### RESULTS WITH POTASH UPON VARIOUS CROPS.

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QUOTED FROM EXPERIMENT STATION BULLETINS.

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## The Proper Composition of Fertilizers.

FLORIDA, 1893.

*Fertilizers*—By A. A. PERSONS. Bulletin No. 22, page 16.

“From chemical analyses of the soils of various sections of Florida made in this laboratory, it is made apparent that the soils of this State are universally more deficient in potash than any other element, while phosphoric acid is more generally diffused throughout the soil than either of the others. This fact, taken into consideration along with the other fact that, generally speaking, the character of the crops grown throughout the State is such as requires a predominance of both potash and nitrogen, it would seem, to say the least, that a majority of *fertilizer combinations* put annually upon our markets for sale *are ill adapted* to fruit and vegetable growing. The writer is of the opinion that, as a general rule, it would be well for our manufacturers to reverse the proportions of many of the fertilizer formulas that they are daily commending as admirably adapted to fruit-growing, and have the constituents proportioned about as follows:

Phosphoric Acid.....	5 to 6 per cent.
Potash.....	10 to 12 “
Nitrogen.....	6 to 8 “

“It is confidently believed that a mixture compounded in accordance with the above formula will, in a great majority of instances, yield results far more favorable in the case of fruit crops than the ordinary routine formula that our fruit-growers have been accustomed to use for years.

"And what has been said with regard to fruit-tree fertilizers applies with equal force to vegetable growing."

NEW HAMPSHIRE, 1894.

*Farm-Yard Manures and Artificial Fertilizers*—BY G. H. WHITCHER.

Bulletin No. 21.

Under the heading of "Substitutes for Farm-Yard Manures," the Director has the following remarks to make :

"The results of all our work show, without exception, that New Hampshire soils are more in need of potash than any other element of plant-food, and consequently that we may so compound our fertilizers that better results shall follow their use than is possible with the average fertilizer found in our markets, and this the farmer is enabled to do by buying his crude fertilizing chemicals and mixing as his soils and crops require . . . .

"These results represent more than 500 individual tests, and it cannot be that the results thus obtained are accidental; they rest on some law, and from a study of the conditions of the experiments we are brought to the conclusion that the prepared goods are deficient in potash. The following table shows the per cents of nitrogen, phosphoric acid and potash in the combinations of chemicals that in actual practice have proved best :

	NITROGEN. Per cent.	PHOS. ACID. Per cent.	POTASH. Per cent.
Best results on plots at Hanover come from mixtures containing.....	2.5	5.75	25.0
Best results on seven New Hampshire farms (husked corn).....	4.7	9.0	10.7
Best results on seven New Hampshire farms (fodder).....	2.3	9.5	11.9
Best results on Potatoes.....	2.3	11.6	7.1
Best results on Sweet Corn.....	2.1	10.8	11.0
Best results on Ensilage.....	1.0	4.0	24.0
Best results on Potatoes, (second series)....	2.3	9.7	12.4
Average composition of mixtures of chemicals that have produced best results. ....	2.4	8.6	14.6
Average composition of fertilizers sold in the state.....	3.0	12.0	3.0

As a result of the experiments several standard combinations and mixtures are recommended for the various crops and in speaking of the chemicals to be used in supplying the fertilizers, Prof. Whitcher says: "These chemicals are all dry, harmless substances, as easily mixed



as corn meal, shorts and middlings. The combinations are vastly superior to the prepared fertilizers on the market, chiefly because they are entirely soluble and contain a high per cent. of potash."

The general conclusions of all the experiments are summed up as follows: "On an average, on New Hampshire soils and with general crops, \$1.00 invested in the best prepared fertilizers has given an increase of crop valued at \$2.34, while \$1.00 invested in the chemicals—dissolved bone black, muriate of potash and sulphate of ammonia—has given an increase valued at \$3.56, a difference of \$1.22 in favor of and due entirely to the substitution of chemicals for prepared fertilizers, at equal cost."

The difference is due chiefly to the wrong proportions of plant-food in the prepared fertilizers, and more to the deficiency of potash than any other cause—

Prepared fertilizer gives.....	{	Phosphoric Acid.... 12.0 per cent.
		Potash..... 3.0 "
		Nitrogen..... 3.0 "
While the chemicals that give best results	{	Phosphoric Acid.... 8.6 per cent.
contain.....		Potash..... 14.6 "
		Nitrogen..... 2.4 "

### NORTH CAROLINA, 1895.

*Fertilizers—Trucking in the South*—By W. F. MASSEY. Bulletin No. 112, page 83.

"Few if any of the brands of mixed fertilizers have as high a percentage of potash as most truck crops require, and the practice of home mixing of the fertilizer ingredients is annually becoming more common."

### MISSISSIPPI, 1893.

*Fertilizers*—Sixth Annual Report, page 42.

"For soils containing an abundance of lime, but little phosphoric acid is needed, while potash in some form has always invariably given good results."

### KENTUCKY, 1888.

By M. A. SCOVELL, LEXINGTON. Bulletin No. 17, 1889.

"The results are so marked as to strongly indicate that for corn potash is a fertilizer needed on the soil of the Experiment Station Farm.

"This holds true for potatoes also. The results on hemp and tobacco prove the same to be true of these crops, and there are strong indications that the wheat will be greatly benefited by the application

of potash. This would indicate also that the soils of like character in the Blue Grass Region would be benefited by potash fertilizers, but this actual trial can only demonstrate.

"There were last year legally on sale in this State forty-three different brands of fertilizers containing less than 2 per cent. of potash; should we have applied any of these to our soil for corn, no marked increased yield would have been apparent, not because the fertilizers were worthless, but because they did not contain the potash necessary for corn crop on our soil."

#### MASSACHUSETTS (Hatch Station), 1892.

*Special Corn Fertilizer vs. A Fertilizer Containing a Larger Proportion of Potash.* Bulletin No. 18. April, 1892, page 90.

"This experiment appears, then, to indicate the correctness of the opinion that the so-called 'special corn fertilizers' contain the elements of plant-food in unsuitable proportions for our common soils. There is especially too much phosphoric acid and too little potash.

"Farmers can, I believe, as a rule, do better than to buy them; they should rather buy the materials needed and mix for themselves."

#### NEW JERSEY, 1892.

*Fertilizers*—Thirteenth Annual Report, page 27.

"The increased yields from chemical manures alone and throughout a series of years have been more satisfactory and profitable than those from the use of natural manures. The most progressive and prosperous truck and fruit farmers in this State are satisfied of this fact and buy chemical manures only."

### APPLES.

#### NEW YORK (Cornell Station), 1894.

*Orchards*—By L. H. BAILEY. Bulletin No. 72.

"Potash is generally the most important element to be applied directly to orchards, particularly after the trees have reached bearing age.

"Muriate of potash is perhaps the best and most reliable form in which to supply potash at the present time."

"Potash should undoubtedly be the leading factor in orchard fertilizers, and nitrogen, as I have said, may be obtained mostly by means of tillage and green crops."

1895.

By L. H. BAILEY. Bulletin No. 84.

"Potash is considered to be the dominant factor in fruit production; this and phosphoric acid should be added each year."

**ASPARAGUS.****MARYLAND, 1892.**

On March 14th, 1892, the following letter from a truck farmer, in the vicinity of Baltimore, Md., was received:

"Relative to the use of kainit on my asparagus bed, would say that I have tried all kinds of fertilizers, and none have ever given one-half the result of kainit. I used it in a generous manner, say about three-quarters of a ton to an acre. I have been a successful asparagus grower for the last twenty years, and the year I had the most success was when I put a ton per acre; I then cut \$1,000 from an acre and one-half of ground.

G. W. RIDGELY,

Liberty Road, Baltimore, Md."

**BEANS.****RHODE ISLAND, 1890.**

By C. O. FLAGG, DIRECTOR. Third Annual Report.

"2. An application of sulphate of potash increased the yield 38 per cent."

**CLOVER.****NEW JERSEY, 1884.**

By C. W. LARISON, RINGOES, HUNTERDON Co. Fifth Annual Report.

"Muriate of Potash alone increased the yield by over 1,300 lbs."

1889.

By A. P. ARNOLD, VINELAND; CUMBERLAND Co. Tenth Annual Report.

"This ends the second year of the four years' rotation on this farm. No fertilizers were applied in 1889; the experiment shows, therefore, the accumulative effect of the applications during the preceding seven years. The residue of plant-food previously applied was effective in increasing the value of the crop in a very marked degree, ranging from \$4.13 to \$32.76. In considering the total net gain for eight years, it is to be seen that muriate of potash applied alone produced the largest profit from the investment, viz.: \$88.49, from an outlay of \$21.00.



"Continued application of barn-yard manure is not the most economical method of supplying plant food."

#### NORTH CAROLINA, 1882.

By C. W. DABNEY, DIRECTOR. Fifth Annual Report, page 75.

"The results are favorable. A very distinct and important effect of kainit is to suppress the growth of weeds and the coarser, rougher grasses in meadows."

#### CORN.

#### CONNECTICUT, 1889.

By M. H. DEAN, LIME ROCK. Second Annual Report, 1889.

Soil—A river terrace formation (on the Housatonic River).

"The most marked effect came from use of potash salts. In every case where potash was omitted there was a marked falling off in the yield of grain, and the stalks were small and slender."

"The average gain from the use of potash is three times that from nitrogen. Potash was plainly the 'regulating ingredient' in the experiment."

By MARION H. DEAN, FALLS VILLAGE. Second Annual Report.

Soil—Light sandy loam (on the Housatonic River).

"The most marked features of the experiment are the heavy increase resulting from the use of potash, and the very slight benefit arising from the use of phosphoric acid. After deducting the average yield for the nothing plots, from plots 1, 2 and 3, it is found that potash alone increased the yield eight times over the nitrate of soda plot, and fifty times over the phosphoric acid plot. With corn estimated at 50 cents per bushel, and stover at \$8.00 per ton, the financial results on these three plots are: From the use of nitrate of soda, \$1.77 loss; from the use of dissolved bone black, \$3.76 loss, and from the muriate of potash, \$13.17 gain."

1891.

By H. W. SADD & SONS, WAPPING. Fourth Annual Report.

Soil—Light loam.

"A fertilizer containing all the three ingredients—nitrogen, phosphoric acid and potash, with the potash in quite large proportions—seems to be the best mixture for corn on this soil."



RESULTS OBTAINED AT THE INDIANA EXPERIMENT STATION.

### INDIANA, 1895.

By H. A. HUSTON, LAFAYETTE. Bulletin No. 57, 1895.

Soil—unproductive peat. Interesting experiments show that unproductive peat soils can be made very productive by the single use of kainit.

“In this experiment it appears that the best yield was obtained from the use kainit; the next best from the use of kainit and lime.

“But it is to be noted that on both plots 4 and 9, where kainit and lime were used, that the yield is less than where kainit alone was used.

Commercial bearings of the work:

“The net returns from the use of one ton of kainit per acre are not less than 54 bushels per acre for four years, or a total of 216 bushels. A ton of kainit can be purchased and distributed on any field in Indiana for not more than \$20. During these years the average selling price of corn at this point is estimated at 35 cents, giving a return of \$75.60 for the investment of \$20.”

### KENTUCKY, 1888.

By M. A. SCOVELL LEXINGTON. Bulletin No. 17, 1889. Soil—Blue grass. The results indicated that a large increase resulted from an application of potash (an increase of from 30 to 50 bushels of ear corn per acre.)



"In examining these results it will be noticed: That in those plots where potash was one of the ingredients of the fertilizer applied, there was a marked increase in the yield of corn and fodder.

"That, therefore, potash was what caused the great increase in both yields of corn and fodder.

"Plot 2 received at the rate of 100 lbs. of potash per acre, and the yield of corn was 63.4 bushels. Plot 7a received at the rate of 160 lbs. of sulphate of potash per acre, and the yield was 80 bushels. This would indicate that 100 lbs. of sulphate of potash per acre was not sufficient to produce a maximum crop. It is probable that even 160 lbs. was not sufficient to produce the best results.

"Proceeding to a discussion of these results it appears: 1. That there was a profit in every instance where potash was used. Potash used alone on plot 7 b. yielding the largest profit."

#### 1889.

By M. A. SCOVELL, DIRECTOR AT THE STATION. Bulletin No. 33.  
Soil—Blue grass; limestone soil. The results obtained this year are almost identical with those of the last two years, that is:

"1. That in those plots where potash was one of the ingredients of the fertilizers used, there was a marked increased yield both in corn and fodder.

"2. That in plot 15, where a fertilizer was used without potash, there was scarcely any increase in yield over those plots containing no fertilizer.

"3. That the greatest increased yield was made by using a combination of potash and nitrogen.

"4. The use of muriate of potash alone resulted in a marked increased yield over the plots containing no fertilizers.

"5. That there was a profit in the use of fertilizers in every instance where potash was one of the ingredients—the largest net profit arising from the use of the mixture of nitrate of sodium and muriate of potash.

"6. That there was a loss by the use of fertilizers where potash was not one of the ingredients.

"7. That so far potash has shown its effect the third season after application."

#### 1893.

By M. A. SCOVELL, DIRECTOR. Bulletin No. 45.

"The largest increase of ear corn produced by fertilizers was 29.4 bushels from a combination of muriate of potash, with nitrate of soda.

NO FERTILIZER



PHOSPHORIC ACID



NITROGEN



NITROGEN AND  
PHOSPHORIC ACID



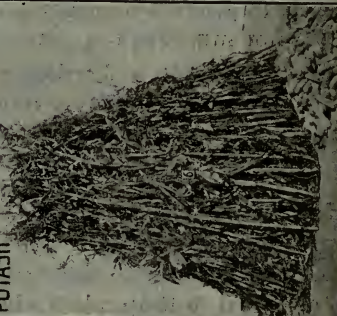
POTASH



PHOSPHORIC ACID  
AND  
POTASH



NITROGEN AND  
POTASH



NITROGEN, PHOSPHORIC ACID  
& POTASH



— SHOWING RESULTS OBTAINED AT THE KENTUCKY STATION IN 1893.



Complete mixture produced 29.1 bushels increase. The largest increase of fodder was 1910 lbs. from the complete mixture, and 1330 lbs. from the muriate of potash and nitrate of soda. The best financial result came from the plot fertilized with muriate of potash and nitrate of soda, amounting to \$4.46 per acre. The next best was from muriate of potash alone, amounting to \$4.34 per acre."

*The Permanency of Effect of Potash Fertilizers*—Bulletin No. 45. The after effect of potash was studied from the yield of a field to which potash was applied in 1888.

"By a study of these tables it will be seen that potash fertilizers applied in 1888 were of benefit to the crops up to and including 1891, and even to some extent in 1892.

"2. That those plots receiving fertilizer in 1889 and subsequently, still show its effect on the crop of 1892. It would seem, therefore, that potash fertilizers supplied to our soil in the quantities given show their effect, not only on the first crop, but also on the three subsequent crops, and to some extent on the fourth."

#### MAINE, 1886.

By A. P. STARRET, WARREN. Report for 1886-87. Soil—Clay loam. The mixed minerals produced an increase of 66.7 bushels of corn.

"When bone black was used alone, the crop was very little better than when no fertilizer was applied, but when this was combined with muriate of potash, the crop increased eight-fold."

#### 1891.

By I. O. WINSLOW, ST. ALBANS. Annual Report for 1891, page 124.

"In this experiment nitrate of soda and muriate of potash gave not only the largest yield, but produced the increase in crop at the least expense for fertilizers."

#### MASSACHUSETTS (Hatch Station), 1889.

By DOLE BROS., SHELBURNE. Bulletin No. 9, May, 1890. Soil—Good medium loam.

"These comparisons make it evident that in this soil potash was the ingredient most needed. Alone, and in combination, it produced a profitable increase."

By W. P. BROOKS, STATION AT AMHERST. Bulletin No. 9, May, 1890. Soil—Alluvial. Potash produced a profit of \$8.66 per acre.

"These combinations make it evident that this soil needed potash. Neither alone nor in combination did nitrogen or phosphoric acid



appear to do much good, and, in some cases, the result of their use was an apparent decrease in the crop . . .

"Potash, on the other hand, appears to have been always and everywhere greatly beneficial. When used alone or in combination, it invariably caused a large increase in the crop, and its use was always exceedingly profitable.

"The lesson of this experiment is plain. For our soil potash should, for the present, be the most prominent ingredient of every fertilizer used.

"General Summary—Results of the use of potash: This ingredient has produced an increase of crop varying from 1.9 bushels of hard corn per acre to 22.8 bushels; and also from 150 lbs. of stover per acre to 1420 lbs. It has proved more useful in its average effect upon the production of hard corn than either nitrogen or phosphoric acid, in four out of eight experiments, and in another it stands on an equality with nitrogen in this respect."

1890.

By W. S. PHILLIPS, MARBLEHEAD. Bulletin No. 14, May, 1891.

Soil—Fine gravelly loam.

"The results of the use of nitrogen and potash are quite similar in kind, though potash causes the larger and the most profitable increase.

"For this soil I should advise a fertilizer rich in potash, containing minerals to furnish about: Potash 80 lbs.; nitrogen, 25 lbs., and phosphoric acid, 25 lbs.

By FRANK WHEELER, CONCORD. Bulletin No. 14, May, 1891.

Soil—Good sandy loam.

"Notwithstanding the high condition of the soil, the potash wherever used produced a very perceptible improvement from the first.

"These combinations make it evident that on this soil potash was the ingredient most needed, but it produces its most marked increase when used with nitrogen and phosphoric acid and more when used with either of these than when used alone."

By A. D. COPELAND, BRIDGEWATER. Bulletin No. 14, May, 1891.

Soil—Very poor gravelly loam.

"The soil needed nitrogen, phosphoric acid and potash; but the latter to a far greater degree than either of the others. They, if potash also was present, produced a considerable increase; but if it was absent, only a very small one. The two together are almost powerless to increase the crop. Potash, on the other hand, even alone caused

considerable increase; with either nitrogen or phosphoric acid the increase due to potash is doubled; with both of them and potash, the increase due to the latter is doubled yet, a gain amounting to no less than 17 bushels of corn per acre."

By PLINY MOORE, WORCESTER. Bulletin No. 14, May, 1891.

Soil—Good medium loam.

"The striking benefit of potash as compared with nitrogen and phosphoric acid is clearly brought out by these comparisons.

"For corn on this soil I should recommend the use of fertilizer rich in potash and phosphoric acid, and with a small percentage of nitrogen."

By L. W. WEST, HADLEY. Bulletin No. 14, May 1891. Soil—A clayey loam, with clayey subsoil. A gain of \$40.46 per acre has been produced by fertilizers rich in potash.

"All through the season it was evident that the growth was far more benefited by potash than by any other element.

"These figures make evident in a striking manner the beneficial effect of potash.

"Alone, and in every combination, potash produces a remarkable increase; but nitrate of soda, too, seems to have been required, for the combination of this with potash produces a much larger crop than potash alone.

"For this soil I am confident that the most profitable results would be obtained by using light dressing of manure with a little quick-acting nitrogenous fertilizer and a considerable amount of potash."

By D. B. DEWEY, NEW LENON. Bulletin No. 14, May, 1891.

Soil—A fine compact loam, inclined clayey and cold. A profit of \$8.25 was obtained by potash.

"In July the plots which had received potash appeared to be doing distinctly better than the others.

"These comparisons make it evident that this soil most needed potash, which alone and in nearly every combination seemed to have produced a profitable increase.

"For this soil it is evident that for corn, a fertilizer should be rich in potash."

By W. P. BROOKS, STATION GROUNDS, SOUTH ACRE, AMHERST. Bulletin No. 14, May, 1891. Soil—A fine yellow loam.

"These comparisons make it evident that this soil still needs potash in greater amount than either of the other elements of plant-



food. The gain from its use alone on plot 4 amounts to no less than \$14.66. Other plots gave larger crops; but no other equalled this one in point of profit on the fertilizer used. The result last year was similar; and it is true for both years that, even if labor be taken into account, the plot where potash alone was used gave the largest net profit.

"If fertilizer only is to be used, I would recommend materials which would supply per acre about 80 lbs. of actual potash, 30 lbs. of phosphoric acid, and 20 lbs. of nitrogen in available forms."

By W. P. BROOKS, STATION GROUNDS, NORTH HALF ACRE, AMHERST. Bulletin No. 14, May, 1891.

"The teaching of the results brought out by these comparisons is plain. The soil most needs potash for the profitable production of corn, and this would be supplied to the full extent used in our experiments."

By G. L. COOLEY, NORTH HALF ACRE, SUNDERLAND. Bulletin No. 14, May, 1891. A gain of \$13.92 per acre was obtained by the use of potash.

"The indication is very strong that the fertilizer for corn must be rich in potash to give profitable returns on this land.

"Conclusions:

- "1. Our results show that soils differ widely in their requirements.
- "2. Potash, however, proves much more largely beneficial than either nitrogen or phosphoric acid.
- "3. Potash, as a general rule, most largely increases the yield of grain and stover; but its effect upon stover production is greater than upon grain production.

"Barn-yard manures are, as a general rule, relatively deficient in potash, probably because of the loss of a large proportion of the urine which contains about four-fifths of the total potash of the excretions."

1892.

By F. E. CLARK, WILBRAHAM. Bulletin No. 18, 1892. Potash produced a gain of \$12.72.

"The comparisons indicate the surpassing importance of potash for corn upon this soil, thus confirming the general result of the work with corn during the two preceding years. In view of the almost universal response of corn to this fertilizer upon soils of so many different classes, and of all degrees of fertility, and in so many widely separated localities, the conclusion that it should be a prominent ingredient for fertilizers used in this crop appears to be irresistible."



THE RESULTS OF THE ADDITION OF POTASH TO BARN-YARD MANURE FOR CORN. Bulletin No. 18, April, 1892, page 87. The result obtained by barn-yard manure was compared with that obtained by the application of a smaller quantity of barn-yard manure mixed with potash salts.

"These figures and comparisons show that the manure alone produces slightly the better crop, but estimating manure at \$5 per cord and muriate of potash at \$45 per ton, shelled corn at 65 cents per bushel and stover at \$5 per ton, we find that the manure and potash, although producing a slightly less valuable crop, gave a financial result nearly \$9 better than manure alone."

SPECIAL CORN FERTILIZER VS. A FERTILIZER CONTAINING A LARGER PROPORTION OF POTASH. Bulletin No. 18, April 1892, page 90.

"In view of confirmatory results of the past year's work, as compared with that of previous years, I renew with increased confidence the recommendations for the application of fertilizers for corn, made in Bulletin No. 14 of this Station:

"(a) In breaking up sod-land for corn, particularly that which is in fair condition, but which has been under ordinary farm management, if fertilizers only are to be used, apply those which are rich in potash. Use materials which will supply 80 to 100 lbs. of actual potash, from 25 to 30 lbs. of phosphoric acid, and from 15 to 20 lbs. of nitrogen per acre.

"(b) If 'special corn fertilizer' is to be used, apply only a moderate quantity, say 400 to 500 lbs. per acre, and use with about 125 lbs. of muriate of potash. It is believed this combination will produce as good a crop as 800 to 1,000 lbs. of 'corn fertilizer,' and it will cost considerably less.

"(c) With ordinary barn-yard manure or stable manure for corn, use potash. I would recommend using about 4 cords of manure and 100 lbs. of muriate potash per acre.

"(g) For fodder or ensilage corn, use either in fertilizers or with manure about one-fourth more potash than above recommended."

1895.

BY WILLIAM P. BROOKS, AGRICULTURIST. Thirteenth Annual Report.

"1. The application of muriate of potash has so invariably increased the yield of both stover and grain that the conclusion is irresistible that potash should be more abundant in fertilizers for this crop than is usually the case,

"2. There is much evidence that the fertilizer for one acre should furnish at least 80 to 100 pounds of actual potash.

"3. A corn fertilizer containing 5 per cent. of potash, applied at the rate of 1,000 lbs. per acre, furnishes 50 lbs. of actual potash. With such a fertilizer it will pay to use from 75 to 100 lbs. of muriate of potash per acre.

"4. Four cords of average farm-yard manure will supply about 96 lbs. of actual potash; but not all of this will be available the first year, hence it will in most cases be found profitable to use with this manure 75 to 100 lbs. of muriate of potash for corn."

#### MISSISSIPPI, 1890.

BY PROF. CONNELL, AT THE STATION. Third Annual Report, 1890.  
Soil—Sandy clay hill.

"Four hundred pounds of kainit used alone produced the highest profit from the crop, amounting to \$17.66 per acre."

1893.

BY S. M. TRACY, DIRECTOR. Sixth Annual Report. The following are the results of three years' experimenting upon corn:

"In 1891 the plots receiving 250 pounds of kainit yielded 36.9 bushels per acre, an increase of 10.1 bushels per acre, costing 17.9 cents per bushel for the increase.

"In 1892 corn was planted on a heavy red clay soil from which the surface soil had been badly washed, and which had given a very light crop of lespedeza the previous season. Here the unfertilized check plots made an average of only 18.5 bushels per acre. Cotton seed meal and kainit increased the yield 24.7 bushels; 250 lbs. of kainit made a yield of 33 bushels.

"In 1893 unfertilized plots made an average yield of only 25.6 bushels per acre . . . while 500 lbs. of kainit applied broadcast before planting more than doubled the yield, making an average of 62.3 bushels of shelled corn per acre. The cost of the increase of 36.7 bushels per acre was a trifle less than ten cents per bushel."

#### MISSOURI, 1890.

BY H. J. WATERS, ASSISTANT AGRICULTURIST. Bulletin No. 14, April, 1891.

"So far it appears from these trials that potash is the element most desired by corn on our land."



**NEW HAMPSHIRE, 1888.**

By G. H. WHITCHER, DIRECTOR. Bulletin No. 6. The experiments cover a period of four years (1885-88). The results show that potash is the leading element of plant-food in this soil, phosphoric acid is also needed in small amounts, while there is little need of nitrogen. Where potash was omitted there was no increase of crop.

"From what has been said it is evident that potash stands first, phosphoric acid second, and nitrogen last. In fact, we should use nitrogen but sparingly, and only when direct experimental work proves it to be beneficial.

"These results, almost without exception, seem to warrant the conclusion already expressed that potash and not phosphoric acid is the controlling factor.

"Experiments made in other parts of the State on soils differing greatly from the Connecticut River land, show even more marked results."

**1889.**

CO-OPERATIVE EXPERIMENTS BY G. H. WHITCHER, DIRECTOR. Bulletin No. 10, March, 1890. The object in view in making these experiments was to find out what composition of fertilizers would suit best for the State at large. Another object was to compare the effect of artificial fertilizers with the effect of stable manure, and also to investigate if the composition of mixed fertilizers as they are usually sold in the State is best suited to the crops. Ten dollars' worth of fertilizer and fifteen dollars worth of manure were used per acre. The experiment demonstrated that artificial fertilizers are equal in effect, if not superior, to stable manure, and that commercial fertilizers are deficient in potash.

"The effect on husked corn from manure was 89.69 bushels, from the best three combinations of chemicals 90.62 bushels, from prepared fertilizers 63.58 bushels, from ashes 65.40 bushels, and from plots not fertilized 41.00 bushels.

"Comparison of composition of fertilizer mixtures that produced best results with the average composition of eighteen commercial fertilizers sold in New Hampshire in 1890:

	Chemicals Producing Best Results.	Average of Fertilizers sold in N. H. in 1890.
Phosphoric Acid.....	9.25 per cent.	11.08 per cent.
Potash.....	11.3 " "	2 57 " "
Nitrogen. ....	3.5 " "	2.45 " "



"The difference is very easily seen, and we are forced to conclude that our fertilizers are deficient in potash."

#### NEW JERSEY, 1883.

By JOHN VOORHEES, SOUTH BRANCH, SOMERSET Co. Annual Report for 1883, page 52. Soil—Red shale loam.

"Plots on which potash was used, both alone and in combination with phosphoric acid and nitrogen, show an enormous increase in yield.

Plot 4 (potash alone) shows that an outlay of \$3.25 per acre increased the yield of corn 29.5 bushels, and stalks 1,000 lbs., a net profit of \$16.00.

"The application of potash yields large profits in every case; phosphoric acid was profitable in one case only, and that when in combination with potash; nitrogen does not increase the yield in any case.

"The quality of corn was also favorably influenced by the use of potash, a fact indicated by the increase in yield of soft corn, which in every case varied considerably. These results confirm those obtained last year by Rev. Henry P. Thompson, of Readington, whose farm is situated about three miles northeast of Southbrook.

"Both experiments show that large profits were derived from the use of potash and phosphoric acid, though the effect of potash alone is more striking in the case of Mr. Voorhees, the soil of this section being mostly red shale loam. And it is more than probable that these experiments by Mr. Thompson and Mr. Voorhees may serve as guides in the use of fertilizers to all farmers upon similar soils."

#### 1884.

By N. S. SERGENT, SCHOOLEYS MOUNTAIN, MORRIS Co. Fifth Annual Report. Soil—Gneissic.

"Muriate of potash, both alone and in combination, had a noticeable effect upon both grain and stalks."

By J. W. DALRYMPLE, HOPEWELL RIVER, MERCER Co. Fifth Annual Report. Soil—Red shale.

"Potash and its combinations being relatively cheaper, give largest profits."

#### 1886.

By T. H. WEST, COLLEGE FARM, NEW BRUNSWICK. Seventh Annual Report.

"Of all elements, potash influences stalk development most favorably, and when used alone, its yields excel those from its combinations."

By A. P. ARNOLD, VINELAND, CUMBERLAND CO. Seventh Annual Report. Soil—Very sandy loam.

Financial results: "Potash influenced the profits in a very marked manner, the increased returns from its use were sufficient to leave a balance of \$21.59 after fertilizer charges had been met and due credit allowed for the product from the unmanured ground; \$21.59 is 180 per cent. of \$12.00, the cost of 600 lbs. of muriate of potash."

### 1888.

RESULTS OF EXPERIMENTS SINCE 1882. The experiments on corn by Mr. Thompson and Mr. Voorhees were valuable in showing the positive effect of potash, and, Mr. Thompson's experiment reported in 1882, indicated that while all fertilizing elements were effective, the largest profit for the money invested was secured from the use of potash. The calculated net profits from and the percentage returns on the money invested per acre for the effective elements are as follows:

	Cost.	Net Profit.	Per Cent. on Money Invested.
Nitrogen, Phosphoric Acid, Potash....	\$14.35	\$ 4.19	28
Phosphoric Acid and Potash .....	9.00	15.50	172
Phosphoric Acid.....	5.25	10.15	193
Potash.....	3.75	13.65	364

"The returns on the money invested range from 28 per cent. to 364 per cent. Mr. Thompson has continued the use of potash upon corn and has secured uniformly profitable results up to the present time. His experience also shows that kainit, while it costs more per pound of actual potash than muriate of potash, has been more economical.

"The experiment of Mr. Voorhees, reported in 1883, shows that wherever phosphoric acid and nitrogen were used, either alone or together, the increase in yield was secured at a loss; that muriate of potash alone costing \$3.25 per acre, increased the yield of corn 29½ bushels and the stalks by 1,000 lbs., that when potash was used in combination with either nitrogen or phosphoric acid, or with both, as in complete manure, the increase in yield secured was almost proportional to the increase secured from the use of potash alone. That is to say an addition of nitrogen to potash, or of both nitrogen and phosphoric acid to potash reduced the percentage of profit secured from the use of potash alone in direct proportion to the cost of nitrogen and phosphoric acid.

"In 1884 Mr. Voorhees, governed by the results secured in 1883, broadcasted one ton of muriate of potash, costing \$40, upon 13 acres of corn ground. Careful measurements of the yield from this area, compared with a portion of the field left unfertilized, showed an increase of 30 bushels of ears per acre, which, at ruling prices for that year, gave a net profit of \$57.50, or 144 per cent. on the investment."

#### **NORTH CAROLINA, 1882.**

By C. W. DABNEY, DIRECTOR. Annual Report for 1882.

"Many of the effects of kainit are general and not restricted to cotton. It greatly increases, for example, the yield of corn on certain cotton land when applied in connection with lime."

#### **OHIO, 1889.**

By B. H. BROWN, BUTLER CO. Bulletin No. 1. Soil—Stiff clay. The average of the unfertilized plot was 24.9 bushels. Increase due to potash alone was 18.3 bushels. Increase due to combined minerals, 23.7 bushels.

"It will be seen that in this test phosphoric acid and potash seem to have been most effective in increasing the crop."

#### **CONSIDERATION OF THE RESULTS OF THE FARMER'S EXPERIMENTS.**

Bulletin No. 2. From the table, giving the results of the eight experiments made, it is to be seen that potash alone caused an increase of 154 bushels in Kicking County, and of 18.3 in Butler County. From the combined minerals an increase was produced in five cases.

#### **RHODE ISLAND, 1890.**

By C. O. FLAGG, EXPERIMENT STATION, KINGSTON. Bulletin No. 8. Average yield unmanured, 15.71 bushels. The highest increase over unmanured 45.71 bushels from mixed minerals, yielding a profit of \$33.85. Muriate of potash alone was most profitable and yielded an increase of 28.57 bushels, worth \$20.70, at an outlay of \$3.60 (more than 600 per cent. profit).

#### **Conclusions:**

"1. The soil appeared to be deficient in potash, phosphoric acid and nitrogen. Potash appeared to be especially lacking, next phosphoric acid, and finally nitrogen."

#### **WEST VIRGINIA, 1893.**

By D. D. JOHNSON, AGRICULTURIST. Bulletin No 29, page 83. Experiments were made at four places in this State—in Berkeley County, in Upshur County, in Wood County, and in Putnam County—for



the purpose of comparing the results from muriate of potash, sulphate of potash magnesia and kainit as fertilizer for corn.

"There is an increased yield on all of the third series of plots where the potash fertilizer is supplied by sulphate of potash, the most remarkable increase being on plot 28, where sulphate of potash alone is used."

## COTTON.

### ALABAMA, 1890.

EXPERIMENT BY J. S. NEWMAN, DIRECTOR, AND JOSEPH CLAYTON, ASSISTANT AGRICULTURIST. Bulletin No. 22.

"Kainit causes the cotton plant to retain the leaves, while they blighted where none was used. . . .

"The per cent. of profit from a judicious use of fertilizers, followed by intelligent cultivation, is most satisfactory."

### ALABAMA (Auburn Station), 1892.

BY J. H. RADNEY, ROANOKE, RANDOLPH CO. Bulletin No. 34.

Soil—Sandy loam. Subsoil—Clay.

"By noticing the yield from plots 1, 2 and 3, where the fertilizers were applied singly, it will be observed that muriate of potash gives the best results."

### GEORGIA, 1893.

BY R. J. REDDING, DIRECTOR. Bulletin No. 20.

"The fertilizing ingredients contained phosphoric acid, nitrogen and potash and were used in this experiment in various proportions, in order to study the best combination of the fertilizer for cotton. It was found that a fertilizer containing 3 per cent. of potash produced the best results.

"And it would require 700 lbs. of such a fertilizer per acre to produce the same increase on similar soil to that of the experiment under consideration. In other words, 700 lbs. of a fertilizer analyzing as the above may reasonably be expected to increase the yield of land in fairly good condition by 1,000 lbs. Such an amount of fertilizer would cost \$8.00 or \$9.00, and the increased yield of cotton would therefore cost about 80 or 90 cents per hundred weight of seed cotton, or less than 3 cents per pound of lint, ready to gather from the field. The results of the experiments of the past year agree substantially, and in most cases remarkably, with those of 1891, and confirm the general conclusion that high farming, including renovating crops, such as cowpeas and other legumes, deep preparation, liberal manuring, select seed, and frequent shallow cultivation is the solution of the problem of 'how to make farming pay.' It has never 'paid' to continually cultivate a poor

and unfertilized soil, and it never will. Fertilizers, domestic and commercial, should be considered in the nature of an investment that entails but little expense after paying the first cost, and they generally repay the cost and a profit of from 100 to 500 per cent.

"Think of it: We have shown that \$8.00 worth of a well-balanced fertilizer may be expected to increase the yield of seed cotton, on one acre, 1,000 lbs., which are worth \$30.00, leaving \$22.00 of profit, or say \$20.00, which is 250 per cent. on the cost.

"But such results can only be attained by concentrating the fertilizer on the best land, not by scattering it at the rate of 100 or 200 lbs. to the acre over a large, worn-out plantation. These remarks apply with more or less force to all crops, and especially to those requiring a large amount of labor per acre, and particularly to cotton, tobacco and garden crops."

1894.

By R. J. REDDING. Bulletin No. 27, page 205.

"Experiments made the year before were continued, and it was found that by far the best results were obtained from a fertilizer which would analyze about as follows:

Available Phosphoric Acid.....	10 per cent.
Potash.....	4 "
Nitrogen.....	3 "

LOUISIANA, 1889.

By W. C. STUBBS, DIRECTOR, BATON ROUGE. Bulletin No. 26.

"In plot 14 there seems to be almost an unmistakable indication of benefit from potash."

MISSISSIPPI, 1889.

SEE ILLUSTRATION ON FOLLOWING PAGE.

By S. M. TRACY, DIRECTOR. Annual Report. Soil—Stiff clay, very exhausted.

"It will be seen that the greatest increase of yield came from the plots which received 200 lbs. of kainit per acre, and that this increase was secured at the smallest expense per 100 lbs.—53 cents."

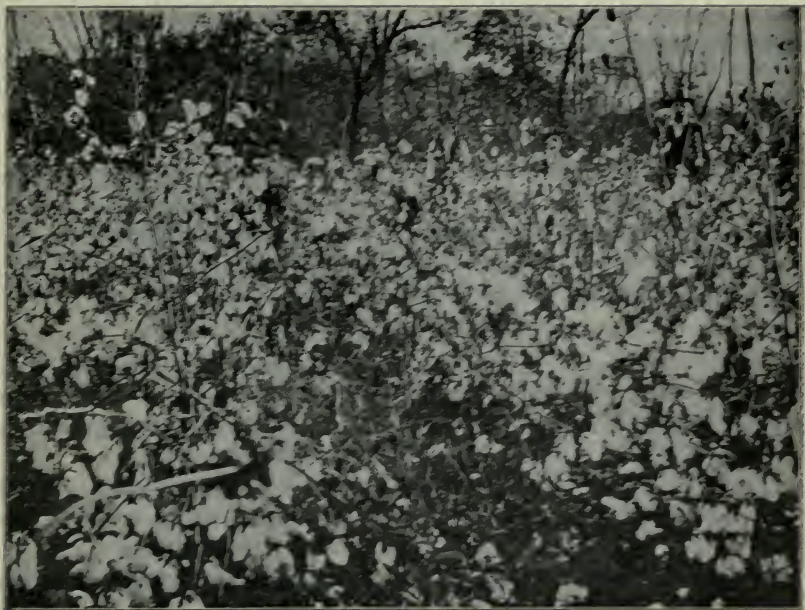
1890.

By G. J. FINLEY, HOLLY SPRINGS BRANCH STATION. Third Annual Report. Soil—Upland clay soil. (Field No. 1.) Kainit alone produced a profit of \$10.58.

"The yields from these plots indicate very clearly the necessity for the use of potash fertilizers, and the still better results to be obtained by the use of a fertilizer containing a fair amount of nitrogen and phosphoric acid in addition. Plot 4, which received 200 lbs. of kainit, gave the largest as well as the most profitable yield of any plot

fertilized with a single ingredient, and a larger yield than did plot 6, where acid phosphate was substituted for one-half the amount of kainit applied to plot 4.

"The Station has been in existence three years, and has tested about fifteen fertilizers each season on the yellow clay soils, which are typical of the hill regions of the State. It has been our uniform experience during three seasons that the purchase of concentrated nitrogenous fertilizers is not profitable, and that potash fertilizers either in the form of kainit, sulphate of potash, or ashes, have always given a fair profit. We have also found that a fertilizer containing a large percentage of potash with a smaller amount of phosphoric acid has invariably given a greater net profit than has any single commercial salt."



EXPERIMENTS ON COTTON AT THE MISSISSIPPI STATION.

1893.

By S. M. TRACY, DIRECTOR. Sixth Annual Report, page 6. From a review of the work done by the Station for several years in regard to fertilizers upon cotton, the following is quoted :

"In 1889 thirty-eight plots were used for tests of fertilizers. These were on a heavy clay soil in an old field, which had been so exhausted



by cultivation that it had been abandoned for many years, such as are not frequent in the hill regions of the State. 'Allen' cotton was used, and the fertilizers were all applied broadcast and harrowed in before planting. Taking 250 lbs., the average of the five unfertilized check plots, as the standard, the greatest increase in yield came from the plots receiving 200 lbs. of kainit per acre, which made an average yield of 495 lbs. per acre. . . . The cost of the 268 lbs. of increase from the plots receiving 250 lbs. of kainit was 70 cents per hundred, which is less than that for any other plot.

"Field No. 3 was on a high ground with a very uniform yellow loam soil, which had been in cultivation many years and had become very much exhausted. It was planted with cow peas in 1890, but produced only a small crop, which was plowed under in January. The previous work of the Station had pointed so strongly to the necessity for using an abundance of vegetable matter and potash on such soils, which are rich in lime, that this field was used for a comparison of the regular "Furman" compost. One thousand pounds per acre of the compost was used. The unfertilized check plots made an average yield of 694 pounds of seed cotton per acre; those receiving the regular "Furman" compost, 862 pounds; while those receiving the more liberal supply of potash, with no phosphoric acid except that contained in the manure and seed, made an average yield of 1126 pounds of seed cotton per acre. This increase was secured at a cost of \$3.25 for the fertilizer used, or 75 cents per hundred pounds of seed cotton. Where the regular "Furman" compost was used the increase was only 178 pounds, or 26 per cent., and this increase was secured at a cost of \$1.83 per hundred pounds of seed cotton. . . . Five hundred pounds of kainit without the compost increased the yield 222 pounds.

"All of the soil used for this work at the home station has been rich in lime and very poor in humus. From the work which has been done here during the last five years the results have been quite uniform, and indicate very plainly that for such soils the first work in restoration must be the providing of a liberal supply of humus, which may come from either stable manure, cotton seed, or the plowing under of green leguminous crops, and that any additional fertilizers used should be rich in potash, though they need contain but little phosphoric acid."

HOLLY SPRINGS BRANCH STATION.

"A number of the fertilizer tests which have been made at the Station were duplicated at the Holly Springs Branch Station in 1890.

The soil there is much less rich in lime than at the home station, is more sandy, and is usually deficient in humus. This work was in charge of the Hon. G. J. Finlay, and results were as follows: Plot 7, which received 200 pounds of kainit, gave much the largest, as well as the most profitable yield of any plot fertilized with a single ingredient, and a larger yield than did Plot 9, where an equal amount of acid phosphate was substituted for one-half the kainit used on Plot 7.

"Field No. 2 was thin clay upland, which had been in cultivation for many years. . . . A mixture of meal and kainit produced the heaviest crop, increasing the yield to 840 lbs., while the yield of the unfertilized check plots was only 331 lbs. of seed cotton per acre.

"Field No. 3 was on low land, the soil being very light, colored and quite sandy. It had been in cultivation fifty years, and was planted with 'Peterkin' seed on May 14. Meal alone failed to increase the crop sufficiently to pay the expense of application and kainit gave the best results of any of the single fertilizers."

FERTILIZERS FOR COTTON. EXPERIMENT BY W. L. HUTCHINSON AND L. G. PATTERSON. Bulletin No. 24. Soil—Yellow loam lands.

"The results obtained from the experiments which have been made indicate that potash is more needed for cotton than any other one ingredient, though a fertilizer which contains a small amount of nitrogen and water-soluble phosphoric acid and a high percentage of potash seems to more adequately meet the demands of these lands."

#### NORTH CAROLINA, 1881.

BY C. W. DABNEY, DIRECTOR. Third Annual Report.

"Kainit has become very popular with cotton planters. It acts probably directly and indirectly. The sulphate of potash it contains is quite a stimulating food to the cotton plant, and it distinctly promotes a regular and early ripening of the cotton, while it appears to be almost a specific against rust. Kainit may be used with advantage, therefore, both on the moist lowlands of the eastern part of the State, and upon hillsides of the west, where cotton is out of its kingdom and has to be hastened to its maturity."

#### 1888.

BY H. B. BATTLE, DIRECTOR. Annual Report.

"Kainit might, with propriety, be used for specific purposes where land is in great need of potash, or as a rust preventive (and undoubtedly it was beneficial for this purpose)."

1893.

By O. W. SUTTON, MT. OLIVE, DUPLIN Co. Bulletin No. 89, page 36.  
Soil—Sandy; clay subsoil. Best financial result came from a mixture of cotton-seed meal with kainit, amounting to \$7.51 per acre from 1039 lbs. of seed cotton against 649 lbs. from unmanured plots. Stable manure produced a financial loss of \$21.84.

"Conclusions: All the fertilizers paid well except phosphoric acid alone. Nitrogen and potash were the dominant elements."

## SOUTH CAROLINA, 1886.

REPORT OF EXPERIMENT FARM. By R. H. LOUGHRIDGE.

"The presence of potash appears to have had more effect on the yield than the ammonia."

Yields: "The acid phosphate alone has yielded 1926 lbs. of seed cotton per acre, while with the addition of kainit its yield is increased 302 lbs."

Profit or Loss: "The mixture acid phosphate and kainit gave a profit of \$6.21."

1888.

By J. M. MCBRYDE, DIRECTOR. First Annual Report.

"It is very clear from these averages that the potash was equally effective at all three farms, showing an increase of from 100 lbs. to 140 lbs. of lint per acre; hence the question of relative cost of the potassic fertilizer becomes an important one.

"The muriate of potash would be preferred as being the cheapest of the three."

1889.

By J. M. MCBRYDE. Bulletin No. 2. This bulletin is devoted to a discussion of the results with fertilizers upon cotton obtained in three years, 1888-90, upon the farms at Spartanburg and Darlington. The soil at Spartanburg is clay loam, and at Darlington sandy loam. The results obtained upon the two farms are much alike, and justify the consideration of both together. They convey a clear idea about manurial needs of cotton upon a certain class of the worn-out soils of the South.

"The combination of potash, phosphoric acid and nitrogen gave an average increase, as compared with unfertilized average, of 300 per cent. at Spartanburg and 250 per cent. at Darlington, and averaged 100 lbs. per acre more lint than any combination of any two of them.



The figures leave no doubt as to the importance of potash, phosphoric acid and nitrogen to cotton."

Potash: "The importance of potash in combination with the other two constituents is unmistakably established. It increased the yield of lint by 95 lbs. at Spartanburg and 108 lbs. at Darlington; the average increase for the two farms is 102 lbs.

"Dealing with the combined averages of the two farms for the three years, and taking the average of the unfertilized plots as one, it appears that potash with the other constituents nearly quadrupled it.

"The enrichment of the impoverished soils is the work, not of months, but years, and can only be economically accomplished in our climate by turning under green crops and other forms of vegetable matter in connection with applications of fertilizers."

## FODDER CORN.

MASSACHUSETTS State Station), 1886.

By C. A. GOESSMANN, DIRECTOR. Fourth Annual Report. Phosphoric acid or nitrogen had little or no effect upon the yield, while potash produced an increase of 300 per cent. and more.

(Concerning trials in 1885): "It was noticed that the applications of potash compounds alone, muriate of potash leading, had exerted a marked effect on the quantity and the quality of the corn fodder raised, increasing the previous annual yield not less than 100 per cent. above that of the preceding year.

"In sight of these facts, it seems but justifiable to conclude, that a deficiency of the soil in available potash had controlled in our case, more than that of any other essential article of plant-food—the final yield of the crop.

"As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it is but a natural result that a soil which originally did not contain more of available potash than of available phosphoric acid, must become unproductive before the latter is exhausted. In case circumstances necessitate a direct succession of these crops, it is well to remember the fact, and to provide against a failure by applying to the soil liberally, in particular, potash compounds in some form or other. Muriate of potash deserves recommendation."

1886.

"The good service of potash compounds is still remarkable."

1887.

By C. A. GOESSMANN, DIRECTOR. Fifth Annual Report.

"The growth upon the plots which had either received no fertilizer, or one which did not contain potash, turned yellowish, ceased to grow, and produced a few imperfect ears, while upon the plots which had been fertilized with a manure containing potash, it retained its healthy appearance, reached its normal height, and produced a liberal number of perfect ears."

Conclusions from three years' experiments: "The beneficial influence of a potash supply on the yield of fodder upon our experimental plots is in every instance unmistakable; while the application of a liberal supply of phosphoric acid and nitrogen, either separately or combined, on the whole, does not materially effect the annual yield, when compared with the unfertilized plots."

1888.

By C. A. GOESSMANN, DIRECTOR. Sixth Annual Report.

"The results of the past season confirm the conclusion presented in our previous annual report. An exceptional deficiency of the soil in available potash, produced by continual rotation of grasses and corn fodder, without any substantial provision for an exceptionally large consumption of potash, proves still the first cause to a reduced annual yield of corn fodder."

## GRAPES.

NEW YORK (Cornell Station), 1894.

By E. G. LODEMAN. Bulletin No. 76.

Speaking of the "shelling" of grapes, it is stated: "Probably more vineyardists agree upon attributing the shelling of grapes to a want of potash than they do upon any other cause advanced. There are several facts which favor the theory."

"An experiment was made by Mr. F. W. Howard, of Fredonia, N. Y., who applied fertilizers at the rate of 200 lbs. per acre as follows:

16 rows, applied a mixture of equal parts Muriate of Potash and Bone.

6 rows Muriate of Potash.

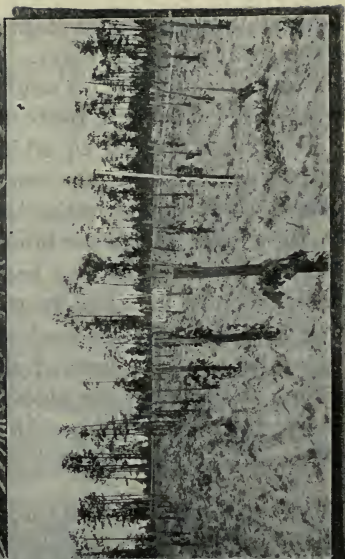
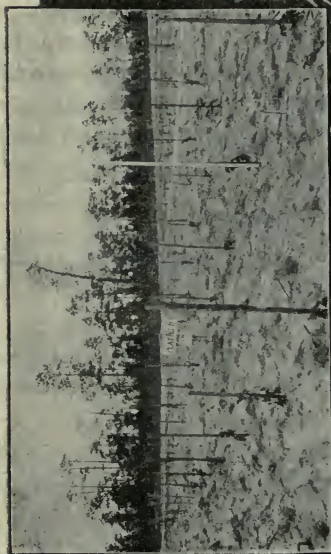
6 rows Bone.

6 rows Tankage.

64 rows equal parts Tankage, Bone and Potash.

7 rows Potash and Bone.

4 rows, nothing.



EXPERIMENTS ON GRAPES, EXPERIMENT FARM AT SOUTHERN PINES, NORTH CAROLINA.



"These applications were made in the spring of 1894, upon land that had shelled in previous years. The results were so plainly marked that there was no room left for doubt as to the requirements of the land in this vineyard. The first plot of sixteen rows shelled, but not seriously. The next six rows, to which muriate of potash had been applied, scarcely lost a berry, nor were leaves 'blighted' to any greater extent than might be expected so late in the season. In passing to the next plot, the one to which the bone was applied, it was unnecessary to ask where the dividing line between the two plots was situated. The difference could be seen to the row. Where the bone had been applied the berries shelled to such an extent that the ground was fairly blue in some places. It seemed as if fully one-third of the crop had fallen. The remainder of the plots showed improvements directly in proportion to the amount of potash used, the other materials applied being apparently without effect."

The following opinions are quoted by prominent growers:

"Ralph Hall, Brocton. Soil, strong shale and loam; fertilizer applied, 400 lbs. low grade potash to a vineyard that shelled in past years; shelling, none in 1894."

"Jonas Martin, Brocton. Soil, strong gravel loam; fertilizers, experience has proved that shelling is not so serious when potash fertilizers are used."

"Geo. W. Marsh, Portland. Soil, heavy gravel loam, inclined to be wet in a low place; fertilizers, used kainit 1 lb. per plant; shelling practically stopped where it was formerly serious, and no blight on the leaves.

"A. H. Harris, Westfield. Soil, rich, dry gravel; fertilizers, 1 lb. sylvinit to the vine; shelling, none where potash was used, some where it was not used."

"G. Schoenfeld, Westfield (formerly had charge of a vineyard). Soil, gravelly loam; fertilizers, 1 to 1½ lbs. of muriate of potash applied in the spring to the vines which shelled the fall before, stopped the trouble."

"Many vineyards have apparently stopped the shelling by applications of potash."

"Potash seems to be the food required by the plant in the majority of the cases in which the vines shell, and it may be wanted in all cases."

## GRASS AND CLOVER.

MASSACHUSETTS, 1895.

BY WILLIAM P. BROOKS, AGRICULTURIST. Thirty-third Annual Report.

"The potash greatly increases the proportion of clover, and thus considerably benefits the first cut of hay, the average increase this year amounting to 569 lbs. of hay for an application of 160 lbs. of muriate of potash per acre.

"The effect of the potash application is most striking upon the rowan crop. This, where timothy, red-top and clover are sown, is always chiefly clover. This year there was not rowan enough to weigh except where barn-yard manure or potash had been applied.

"Muriate of potash applied to land which is to be seeded to mixed grasses and clovers may be depended upon to increase the proportion of clover in the produce, and consequently to make the hay more highly nitrogenous, and particularly to increase the yield of rowan. The amount needed is about 175 to 200 lbs. per acre.

"Fertilizers for top-dressing grass lands in spring should contain nitrate of soda and muriate or sulphate of potash."

NEW JERSEY, 1886.

BY S. P. RIDGEWAY, HURFVILLE, GLOUCESTER CO. Seventh Annual Report. Potash alone and in combination produced a profit.

"It is evident that this result was largely due to the favorable effect produced by the muriate of potash in securing a stand, since, with the exception of plot 11, the crop was very light where no muriate of potash was used."

## HEMP.

KENTUCKY, 1888.

EXPERIMENT BY M. A. SCOVELL, DIRECTOR. Bulletin No. 18.

Soil—Blue grass land, well worn. The experiment shows plainly that quantity as well as quality was improved by applications containing potash. The quality of the potash plots was pronounced to be fair or good, while trashy on all other plots.

"It follows that potash was an essential ingredient of the fertilizer which produced the marked increased growth of hemp."

1889.

BY M. A. SCOVELL, DIRECTOR. Bulletin No. 27. Soil—Very much worn, and would be considered by most farmers unfit for hemp.

From the year's experience, our conclusions are:

"1. That hemp can be raised successfully on our worn blue-grass soils with the aid of commercial fertilizers.

"2. That a commercial fertilizer containing about 6 per cent. available phosphoric acid, 12 per cent. of actual potash, and 4 per cent. of nitrogen (mostly in the form of nitrate of soda or sulphate of ammonia) would be a good fertilizer for trials."

1895.

BY M. A. SCOVELL, DIRECTOR. Bulletin No. 55, page 54.

"The only conclusion drawn is, the results strongly indicate that nitrogen and potash were needed on the plots for hemp."

## OATS.

TENNESSEE, 1889.

EXPERIMENT BY C. S. PLUMB. Bulletin No. 2. Soil—Light loam of clayey character. The highest yield, amounting to 51 bushels, was produced by the simple application of muriate of potash.

Conclusions: "That the two plots fertilized with potash gave the highest yields."

## ORANGES.

FLORIDA, 1892.

BY J. M. PICKEL AND J. J. EARLE. Bulletin No. 17.

"The orange draws potash from the soil in far larger quantity than any other constituent. That is, however, precisely that constituent which is relatively deficient in popular orange fertilizers now on sale in Florida. These fertilizers contain from 1 to 2.5 times as much phosphoric acid as potash and 2 to 5 times as much phosphoric acid as nitrogen. Whereas, according to our analyses, the orange takes from the soil 6 times as much potash and 1.6 as much nitrogen as phosphoric acid (in the case of the California orange, 4 times as much potash and 3 times as much nitrogen). That one of these three most-important constituents, of which the orange removes the least, the one, moreover, which is most likely to be present, and often actually is present in Florida soil in excessive abundance, namely, phosphate, is the one which these fertilizers supply in excess. A fertilizer which



would return to the soil the constituents extracted by the orange, should contain about 2.7 per cent. phosphoric acid, 4 per cent. nitrogen, and 16 per cent. of potash. These remarks have reference to old bearing trees." . . . "The fertilization of fruit trees is a subject about which there is little accurate knowledge, and greatly needs to be studied. The formulas for orange fertilizers undoubtedly need to be revised; the quantity of potash relatively to the other constituents needs to be increased. A fertilizer containing something like 2.7 per cent. phosphoric acid, 4 per cent. nitrogen and 16 per cent. potash would restore these elements to the soil in something like the relative proportions in which the orange takes them. About 12.5 lbs. of this fertilizer would be enough for the production of 1,000 oranges."

## PEACH TREES.

NEW JERSEY, 1883.

By G. H. COOK, DIRECTOR. Fourth Annual Report.

"We recommended the use of muriate of potash to several growers of peach trees in the spring of 1883, and have much satisfaction in learning just now from two of them that their trials with it proved entirely successful as far as one year's experience will go."

1886.

By G. H. COOK, DIRECTOR. Seventh Annual Report.

"The experiments to show the effects of fertilizers upon the growth and productiveness of peach trees are successful, and giving great encouragement to the cultivators, as well as the consumers, of this luscious fruit, by the use of chemical fertilizers, especially of muriate of potash. The trees are now kept in healthy growth and bearing condition for many years, in the very fields where formerly, without the use of fertilizers, the lives of the trees were limited to six or seven years. On unmanured soils the foliage of the trees turned yellow, great numbers of little suckers grew out of the branches, and the trees were said to have the 'yellows,' and soon died. The effect of fertilizers upon the failing trees is so marked that many cultivators of peach trees believe there is no such disease as the 'yellows,' and that their early failure was simply due to the lack of proper plant-food."

SPECIAL REPORT BY J. M. WHITE.

"Dr. Henry Race, of Pittstown, Hunterdon County, who has used potash salts and bone for the past six years, writes: 'In my experience of trees bearing an excessively large crop, they are liable to have an

unhealthy appearance; the leaves turn yellow, small reddish shoots start up from the large branches near the trunk, and the wood soon becomes a dark brownish color. Whether these symptoms represent the specific disease called the 'yellows' or not, muriate of potash and super-phosphate of lime applied as soon as the crop is gathered in the quantity of 400 or 500 lbs. to the acre, with good cultivation and pruning, will prevent this premature decay, or arrest it if just commenced. If the fertilizer is withheld till the wood becomes a dark brown, its application may improve the appearance of the tree, but it will never become healthy and vigorous again."

1889.

BY S. C. DAYTON, BASKING RIDGE, SOMERSET CO. Tenth Annual Report.

"The best yields secured in 1889 were from those plots upon which potash had been applied. The highest yield of 166.7 baskets was on plot 7 from muriate of potash and nitrate of soda."

Considering results for three years: "It will be noticed that percentage of increase due to super-phosphate has gradually decreased, while the favorable effect of muriate of potash has gradually increased since 1887."

1891.

BY S. C. DAYTON. Twelfth Annual Report, page 133. The following are the results from experiments carried on since 1884.

"Super-phosphate and muriate of potash have been effective, though decidedly in favor of the potash.

"The best yield from chemical manures is from the complete fertilizer.

"As in the study of yields, muriate of potash was the most valuable of the single fertilizing elements, having produced peaches at a less cost per basket than either of the combinations, or of all three in the form of a complete fertilizer.

"The best return for the money expended was secured from muriate of potash."

1892.

BY S. C. DAYTON, BASKING RIDGE, SOMERSET CO. Thirteenth Annual Report, page 122.

"The experiments which were begun 1884 were made upon 12 experimental plots, to which various fertilizer combinations and also barn-yard manure was applied. The results of several years' experimenting show, that commercial fertilizers pay better than stable ma-

nure, and that complete fertilizers produce the best results, while an actual gain has been produced by nearly every application.

"Potash has proved the most valuable of the single elements. The average *net gain* from the use of *complete chemical manures* for the six crop years is \$60.51, and only \$36.14 from the use of barn-yard manure, a difference of \$24.37 in favor of the fertilizer, or more than enough to fertilize two acres at the rate at which it was applied on plot 9."

#### 1893.

BY S. C. DAYTON, BASKING RIDGE, SOMERSET CO. Sixth Annual Report, page 138. Potash seems to be the predominant element for peaches. The net gain for five years from the use of complete fertilizer was \$508.40.

"Potash seems to be the ruling fertilizing element for peaches, producing more fruit and of better quality than any of the others. Lime seems good for grass, but very poor for peaches." . . . "Of the single fertilizing ingredients, potash still exerts the most favorable influence."

"Of the single elements, nitrate of soda has not increased the yield; super-phosphate and potash, on plots 3 and 4, have both been effective, though still decidedly in favor of the potash, the net increase in yield on plot 4 being 276 baskets, or 62.8 per cent.

"Of the single elements, potash has proved the most valuable."

#### NEW YORK (Cornell Station), 1894.

BY L. H. BAILEY. Bulletin No. 74.

"I believe that the key-note to the proper fertilization of peach orchards is potash and phosphoric acid, and not nitrogen. . . . Tillage, with green manure crops at the end of the season, can be relied upon to furnish the nitrogen in some instances."

### PEAS.

#### GEORGIA, 1892.

Bulletin No. 17, March, 1892. Soil—Red clay and clay subsoil.

Conclusions: "That mixed minerals (phosphates and potash) gave the most economical results."

#### MAINE, 1891.

BY W. VALENTINE. Annual Report, 1891, page 131.

Summary—The experiment brings out strongly the facts: "2. That phosphoric acid and potash are the most important fertilizing elements for peas."





SHOWING THE EFFECT OF POTASH-PHOSPHATE FERTILIZATION ON COW PEAS,  
EXPERIMENT FARM, SOUTHERN PINES, NORTH CAROLINA.

#### NORTH CAROLINA, 1882.

By C. W. DABNEY, DIRECTOR. Fifth Annual Report.

"Kainit and peas together are undoubtedly the most promising agents we know of for improving our Southern soils. They seem peculiarly adapted to these soils and go together. . . . Mr. A. T. McCallum, Robeson County, compared the effects of ammoniated superphosphate and kainit. He does not give us the figures, but says: 'The plot on which I used kainit made twice as many peas as any one of the others. You could tell very plainly to the very row where the kainit commenced by the peas. Kainit is certainly a god-send to the cotton farmer.'"

#### POTATOES.

CONNECTICUT (Storrs' Station), 1891.

EXPERIMENT BY THE STATION. Fourth Annual Report.

"In the experiment of 1891, the potatoes responded decidedly to potash. On all the plots where this ingredient was used, the vines were heavier throughout the season, remained greener longer, and gave much larger yields than plots which received no potash. Phosphoric

acid, when used alone, or in combination with nitrogen, brought but little over nothing; but when used with potash, its beneficial effects were quite marked.

"The vines upon all the plots receiving dissolved bone black, but without potash, were more seriously affected with blight than those receiving potash."

#### KENTUCKY, 1888.

BY M. A. SCOVELL, DIRECTOR. Bulletin No. 16.

The results show: "That the yield of merchantable potatoes, and also the total yield, was largely increased on those plots containing potash.

"That 200 lbs. of sulphate of potash produced an increased yield slightly exceeding that produced by the application of 80 loads of stable manure.

"That the results were the same as to the yields, whether muriate or sulphate was used."

Summary: "Potash is what is needed on our soil for the potato crop.

"The effect of potash was shown upon the growth of the potatoes, as well as the yield. The vines were much more thrifty and stood the drought better. The potatoes on plots containing potash were larger and more even in size than those on other plots."

Financial results: A profit of \$21.43 was obtained from sulphate of potash alone.

"The results show decidedly that there was a profit in the use of potash compounds, and that the money expended in ammonia sulphate and super-phosphates was entirely lost. Plot No. 11, which received 80 loads of barn-yard manure, probably did not produce an increase enough to pay for the expense of hauling out the manure.

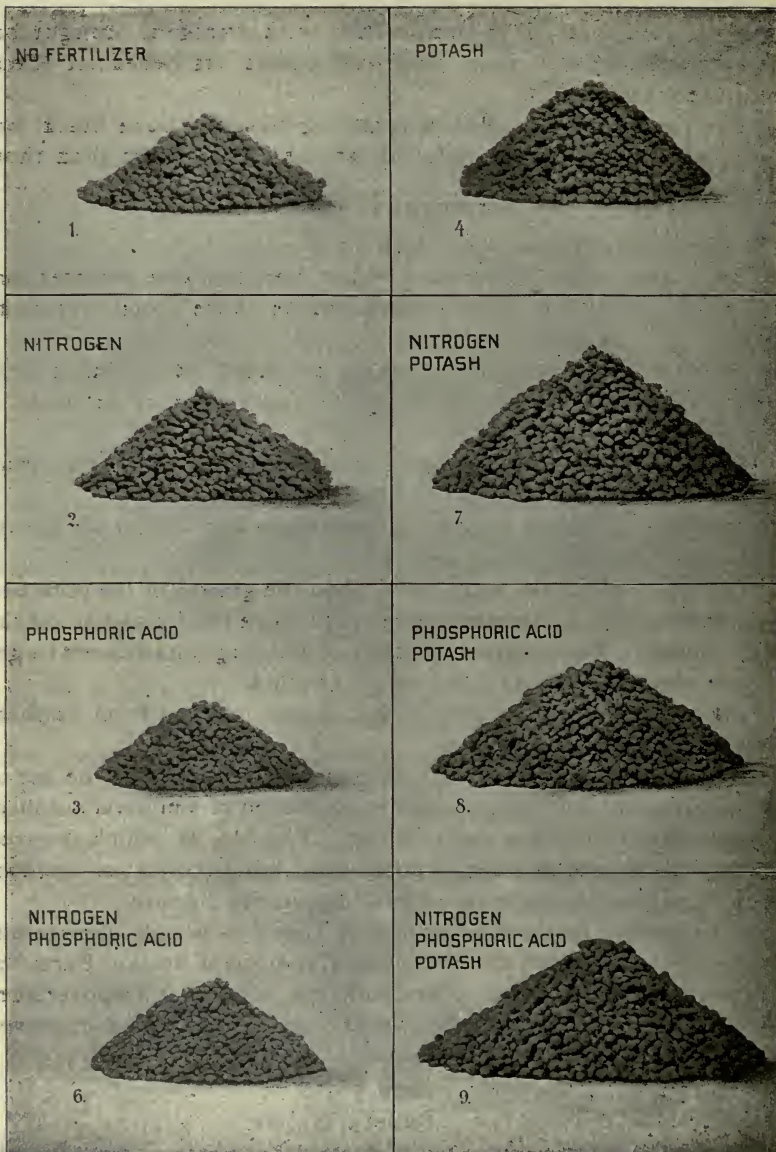
"Thus we find by these experiments, that it is potash compounds that are needed to enrich the soil of the Experiment Station Farm for the production of potatoes. They indicate, also, that impoverished soils of the above class, in the blue-grass region, would be improved by the application of potash compounds."

#### 1889.

BY M. A. SCOVELL, DIRECTOR. Bulletin No. 22.

The results show: "1. That the yields of potatoes were largely increased by the use of sulphate of potash, either when used alone or in combination with nitrate of soda, or with acid phosphate, or with both.

# RESULTS ON POTATOES OBTAINED IN 1895.



KENTUCKY EXPERIMENT STATION.



"2. It appears that neither acid phosphate nor nitrate of soda, when used separately or in combination with each other, were of much or no benefit, but that when either was used with sulphate of potash the results were beneficial as to yield; the greatest yield being produced when both were applied together with sulphate of potash."

The effect of fertilizers on the quality: "It appears from the results that the potatoes from the plots fertilized with potash sulphate alone contained the largest amount of dry matter, and were, therefore, considered the best in quality."

1891.

Bulletin No. 37, December 1891, page 13. The highest profit of \$23.40 resulted from muriate of potash.

"By referring to the table it would seem, that potash greatly increased the yield, while phosphoric acid and nitrogen gave some beneficial effects."

1895.

By M. A. SCOVELL, DIRECTOR. Bulletin No. 61.

"The season was very unfavorable for potatoes, yet the effect of potash was proportionately as great as in previous experiments. The average yield from the unmanured plots was 43 bushels of potatoes per acre, while muriate of potash alone more than doubled the crop, and the complete mixture containing 160 lbs. of muriate of potash produced 126.8 bushels of potatoes."

LOUISIANA, 1889.

By W. C. STUBBS, DIRECTOR, BATON ROUGE. Bulletin No. 26.

"In five cases the meal and kainit gave a larger yield than meal and acid phosphate, despite the fact that the stand of the former was inferior. This would seem to indicate that potash is of some benefit."

MAINE, 1890.

FARMERS' EXPERIMENTS, BY O. B. KEENE, EASTON, AROOSTOOK Co. Annual Report, Part III. Potash and ammonia produced a large increase of potatoes in the experiment.

"This experiment is interesting in showing the remarkable effect of commercial fertilizers on some soils. The average of the plots receiving no fertilizers was 132 bushels per acre. The average of the plots receiving nitrate of soda and muriate of potash was 262 bushels per acre. Here the crop was doubled by adding 150 lbs. of nitrate of soda and 100 lbs. of muriate of potash. The cost of the chemicals in this case was about 4.2 cents per bushel."

1891.

By H. C. TOWNSEND, FORT FAIRFIELD. Annual Report.

"In this experiment all the fertilizers caused an increase in the crop, but the combination of dissolved bone-black and muriate of potash produced the increase at least cost per bushel."

**MASSACHUSETTS (State Station), 1886.**

By C. A. GOESSMANN, DIRECTOR. Annual Report. The experiments of three years, from 1884 to 1886, are considered together. The yield was largely increased by the fertilizers containing potash. In 1884 the plot that received muriate of potash was free from scab.

"The latter (manured with muriate), on the other hand, had the smoothest skins and were almost entirely free from scab, which seriously disfigured those from plots 2 and 3."

1893.

Eleventh Annual Report. The experiment was made to compare the effects of muriate of potash and sulphate of potash upon potatoes. The results are as follows:

"The yield of potatoes is in every instance larger in case sulphate of potash has furnished the potash of the fertilizer used, than where muriate of potash has served for that purpose."

**MASSACHUSETTS (Hatch Station), 1890.**

By H. H. GOODELL, DIRECTOR. Bulletin No. 14.

"Potash for this crop, as for corn, seemed to be most deficient in this soil. This is thus far the only experiment tried under my direction on potatoes, and I am not justified in forming any sweeping conclusions. It, however, appears to me likely that the 'special potato fertilizers' in the market furnish too small a proportion of potash. It will pay, I believe, to use them in moderate quantities, if at all, in connection with sulphate of potash for the heavier and muriate of potash for the lighter soils."

1892.

By W. L. PHILLIPS, MARBLEHEAD. Bulletin No. 18, April, 1892.  
Soil—Gravelly loam.

"These comparisons make it evident that potash was more beneficial than either phosphoric acid or nitrogen. Alone, and in every combination, it much more than pays for itself; but it is far more effective when phosphoric acid is present than when used alone, and

produces a yet larger increase when used in conjunction with both phosphoric acid and nitrate of soda.

"A potato fertilizer for such a soil as this should contain nitrogen, phosphoric acid and potash, and I should judge that materials furnishing per acre, nitrogen, 30 lbs.; phosphoric acid, 60 lbs.; and potash, 100 lbs.; might give a profitable crop."

By FRANK WHEELER, CONCORD. Soil—Sandy loam.

"Potash appears to have been the element 'in minimo.' Even when used alone it produced a profitable increase. But its beneficial effects are greater with either of the other elements than alone, and greatest with both the others."

By L. W. WEST, HADLEY. Soil—Moderately heavy loam. Nitrogen produced a gain of \$5.35, phosphoric acid a loss of \$3.39, and potash a gain \$38.83.

"The superiority of the plots which received potash was evident from an early stage in the growth of the crop.

"This soil stands in greater need of potash for potatoes than of either of the other ingredients of the fertilizer used. It is significant that all the requirements of corn on similar soil, as shown by the experiments of 1889 and 1890, were the same. In view of the confirmatory results of the experiments of three successive years upon it, a very marked deficiency of potash in this soil can not be reasonably doubted."

#### 1892.

GENERAL SUMMARY. The average from all the preceding experiments shows that nitrogen produced 10.74 bushels increase, phosphoric acid 10.11 bushels, and potash 41.55 bushels increase.

"It will be observed that the potash of the fertilizers of every experiment save one (Shelburne), proved much more beneficial in its average effect upon the crop than either nitrogen or phosphoric acid, and the indication is, therefore, that it should be relatively more abundant in fertilizers especially designed for this crop than is usually the case."

AT THE STATION GROUNDS, AT AMHERST, NORTH ACRE. Bulletin No. 18, 1892, Soil—Warm medium loam. Nitrogen and phosphoric acid produced a loss; potash a gain of \$13.60.

"These comparisons make evident the fact that for potatoes, as for corn last year, potash should be a prominent ingredient of the fertilizer used. Neither nitrogen nor phosphoric acid gave results of any great importance, while potash alone, and in every combination, produced a profitable increase."



## 1895.

BY WILLIAM P. BROOKS, AGRICULTURIST. Thirty-third Annual Report.

"1. Eight experiments, comparing the sulphate with the muriate of potash, have given an average 22.1 bushels of merchantable tubers per acre more where the sulphate was the source of potash.

"2. The eating quality of the tubers raised when the sulphate has been the source of potash has generally been better than when the muriate was used.

"3. Analyses have generally shown that the tubers raised on the sulphate have contained less water and more starch than those raised on the muriate."

"1. Both being used in connection with material furnishing equal amounts of nitrogen and phosphates, sulphate of potash gives larger yields of potatoes than muriate of potash.

"2. Used in the same way, sulphate of potash produces potatoes of better quality than muriate of potash.

"3. Potato fertilizers should therefore contain potash in the form of sulphate rather than muriate."

## MICHIGAN, 1892.

BY L. R. TAFT. Bulletin No. 85.

"The nitrogen perhaps had the least effect, but the potash and ground bone, whether alone or together, seemed to increase the yield."

"Even on fairly rich soil manure for fertilizers for potatoes can be used with profit."

## NEW HAMPSHIRE, 1890.

BY S. E. WHITEMORE, COLEBROOK. Bulletin No. 12. The location is in the heart of the potato region of New Hampshire.

"Every test adds to the probability of the correctness of my position relative to the need of vastly more potash than our fertilizer manufacturers give us. . . .

"The conclusion is fully warranted that more potash is needed than the prepared fertilizers furnish."

Conclusion: "The above results so fully confirm previous observations that I shall simply reprint the conclusions given in Bulletin No. 10 of this station, page 12.

"1. Chemicals when properly mixed can fully take the place of farm-yard manure as a source of plant-food.

"2. Chemicals when properly mixed can and do give greater increase of crop than commercial fertilizers.

"3. The average chemical composition of fertilizers for New Hampshire should be phosphoric acid, 9 to 11 per cent.; potash, 9 to 15 per cent.; nitrogen, 2 to 4 per cent., whereas the fertilizers offered us in the market average, phosphoric acid, 11 per cent.; potash, 2.5 per cent.; nitrogen, 2.5 per cent."

#### NEW JERSEY, 1889.

BY J. M. WHITE, NEW BRUNSWICK, MIDDLESEX CO. Tenth Annual Report. Soil—Light, dry sandy gravel.

"Marked effects were observed from the use of both muriate and kainit. . . . At these prices the net profit per acre from the use of muriate of potash was \$13.20; from kainit, \$16.67."

#### 1891.

Twelfth Annual Report, page 108. Experiments were made in three different localities in the State, and on different soils.

The effect of different forms of potash salts: "Averaging the three experiments, the yields from muriate and sulphate are practically identical.

. . . "In the use of muriate or sulphate the main consideration is the cost, the cheaper muriate being quite as effective as the sulphate, and the direct application of large quantities of kainit is not advisable for potatoes."

The potatoes were subjected to a chemical analysis, the result of which demonstrated that sulphate of potash produced the best potatoes. This was confirmed by testing the cooked potatoes.

#### NEW YORK (Geneva Station), 1889.

BY P. COLLIER, DIRECTOR. Eighth Annual Report. It is stated that the ash of potatoes contains 59.8 per cent. of potash, and one of the main objects of the experiment was to find out if the potatoes are largely in need of potash, as indicated by their composition. Potash produced a large increase. The average yield from plots containing no potash is 85.5 bushels per acre; that from potassium sulphate is 112.5 bushels; from potassium chloride 135 bushels.

BY P. COLLIER, DIRECTOR. Special Experiment with Potash and Nitrogen. Ninth Annual Report.

These results indicate: "1. That for potatoes, potassium chloride is a good, safe fertilizer, even on some clay soils, where potash may be said to be present in considerable quantity."

**NORTH CAROLINA, 1888.**

By T. W. JONES, COLUMBIA, TYRREL CO. Annual Report.

"Kainit alone yielded a profit of \$9.30 from an investment of \$2.80."

**OHIO, 1886.**

By N. S. TOWNSEND, DIRECTOR. Fifth Annual Report.

"Wherever potash, alone or in combination, was used, less scabby potatoes were found than upon any other plots. It may not be safe, however, to infer from this that potash prevents scab, but it seemed, in this case, to have that effect to some extent."

**OREGON, 1893.**

By H. T. FRENCH, AGRICULTURIST. Bulletin No. 24. Kainit produced about 145 bushels per acre against 81 bushels per acre unmanured. Unleached ashes produced only 48 bushels.

"This fertilizer, as seen in the table, nearly trebles the yield over the plot where no fertilizer was used. . . . What is said of guano is largely true of kainit (German potash salts) and super-phosphate. These substances cost less than the guano."

**RHODE ISLAND, 1890.**

By C. O. FLAGG, DIRECTOR. Third Annual Report.

"Muriate of potash in combination produced 76 bushels per acre more than the sulphate of potash in combination."

**WEST VIRGINIA, 1892.**

By D. D. JOHNSON, AGRICULTURIST. Bulletin No. 20, January, 1892.

"The best results were obtained from the combination of kainit (800 lbs. per acre) with acid phosphate, causing an increase of 161 1-3 bushels per acre. The increased yield caused by the use of fertilizers was at the rate of 161 1-3 bushels per acre, which, at 40 cents per bushel, amounts to the sum of \$64.53 1-3, leaving a net profit of \$57.43 1-3 per acre, less the increased labor required to take care of the increased crop."

**1893.**

By D. D. JOHNSON, AGRICULTURIST. Bulletin No. 29. This experiment was carried out at the Station and was a repetition of the experiment made in 1891. Three varieties of potatoes were used.

"A combination of kainit and S. C. dissolved bone produced the greatest amount of large and the smallest percentage of small tubers."

"Here again we have a remarkable agreement with the facts brought out in the experiment of 1891. Plot No. 5, without any fertilization, produced 88½ lbs., while plot 1, with 42 lbs. kainit, produced 140.4 lbs."



"Taking the experiments of 1891 and 1892 together we find a very remarkable agreement, even to minute details, and from the results of these experiments, confining our conclusions to the peculiar character and conditions of the soil upon which the experiments were conducted, we conclude that the best results in commercial fertilization, as tested, will be secured by a combination of potash and phosphoric acid in the ratio of 2 to 1."

## POTATOES—SWEET.

### ARKANSAS, 1889.

EXPERIMENT BY A. E. MENKE, DIRECTOR, NEWPORT BRANCH STATION. Third Annual report. Kainit used alone produced the highest profit, amounting to \$25.50.

### DELAWARE, 1890.

BY M. HAYES, DOVER. Bulletin No. 11.

"Nearly \$40 per acre was gained by the use of \$4.00 worth of potash."

SCARLET CLOVER AS GREEN MANURE AND FERTILIZER.

"Of any single element, potash yielded the largest returns. Of the combinations, scarlet clover, potash and phosphoric acid, costing \$8 per acre, returned \$52 worth of potatoes."

BY JOHN DAGER, CAMDEN. Bulletin No. 11.

"Taking all things into consideration, the muriate of potash gave potatoes most uniform in size and best all around for the market, and the probabilities are that Mr. Dager would succeed best by selecting the muriate. Financially, \$4 worth of this salt yielded \$24 worth of product."

BY C. WRIGHT. NEAR SEAFORD, SUSSEX CO. Bulletin No. 11.

"That story is that unfertilized ground can produce 41 bushels of sweet potatoes per acre; but with an excess of potash the same ground could produce 105 bushels, a gain of 64 bushels, worth \$34, for an expenditure of \$4. Both phosphoric acid and nitrogen increased the yields, but relatively to a very trifling extent. The presence or absence of potash determined the crop.

"The results say plainly that potash was needed for that soil and crop.

Conclusion: "On the practical outcome of the series the results are positive enough. Dropping all theories they stand as follows: Muriate of potash when used alone at Dover returned \$8 for every dollar invested in its purchase."

**GEORGIA, 1890.**

By G. SPETH, HORTICULTURIST. Bulletin No. 11. Soil—Red clay, with clay subsoil. The effects of kainit and muriate were alike on the average. The value of increase above the cost of the fertilizer varied according to the variety of the potato—from \$37.43 to \$162.83 per acre. The cost of the fertilizer was \$10.27 or \$9.40 respectively.

"The yield of sweet potatoes is governed by the amount of potash in the fertilizer. A fertilizer, as in the experiment, analyzing 8 per cent. phosphoric acid, 3 per cent. ammonia, and 10 per cent. of potash is the most effective for sweet potatoes."

**1894.**

By H. N. STARNES, HORTICULTURIST. Bulletin No. 25.

In the introduction about fertilizer requirements for the sweet potato the following is said:

"Commercial fertilizers are preferable to stable manure. Recent investigations have developed the fact that the sweet potato feeds much more grossly on both nitrogen and potash and requires less phosphoric acid than was formerly supposed."

By H. N. STARNES, HORTICULTURIST. Bulletin No. 25, page 138.

The yield from the unfertilized plots was 133 bushels. The best yield from the fertilized plots was 278 bushels.

"As a source of potash, kainit seems to be preferable to muriate in nearly every combination, though the difference is not great. In this connection it may be stated that for all slow-growing crops kainit seems to be preferable to muriate, as a source of potash, and cottonseed meal to nitrate of soda as a source of nitrogen. When immediate action is desirable, however, the reverse is the case."

**LOUISIANA, 1892.**

EXPERIMENT BY H. A. MORGAN AND B. E. ROSS AT BATON ROUGE, Bulletin No. 13.

"Sweet potatoes require for their best development a loose pulverulent sandy loam, fairly fertile, particularly so in phosphoric acid and potash."

**MARYLAND, 1892.**

By E. H. BRINKLEY, ASSISTANT AGRICULTURIST. Bulletin No. 18.

Soil—Sandy loam. A study of the results shows that the average yield per acre from the unmanured plots was 3599 lbs. and the highest yield obtained from sulphate of potash used at the rate of 200 lbs. per acre amounted to 6357 lbs. per acre, and the next highest yield came from the use of muriate of potash at the rate of 200 lbs. per acre, amounting to 5920 lbs. per acre.



## NEW JERSEY, 1886.

By P. A. ARNOLD, VINELAND, CUMBERLAND CO. Fifth Annual Report.

"Plots 4, 8, 9 and 11 have given cash returns, ranging from four to eleven times as great as those from the unmanured plots; said plots have also only one point in common, for six consecutive years each has received a heavy dressing annually of potash in a soluble form.

"The conclusion is, therefore, positive, that for raising profitable crops upon this farm with the present rotation potash is absolutely indispensable."

1888.

By G. H. COOKE, DIRECTOR: Bulletin No. 54.

"A field experiment with fertilizers was begun in 1882, by Mr. A. P. Arnold, of Vineland, which shows very clearly two points in regard to potash: First, its directly favorable effect on sweet potatoes, as indicated by the crop of 1883, and second, effect in improving the crop-producing power of the soil as indicated by the second crop of sweet potatoes in 1887.

"At the close of the first rotation in 1885, the following conclusions in reference to potash were reached:

"1. Potash used alone on plot 4 influenced the profits in a very marked manner. The increased returns from its use were sufficient to leave a balance of \$21.59 after fertilizer charges had been met, and due credit allowed for the produce from the unmanured ground. \$21.59 is 180 per cent. of \$12, the cost of 600 lbs. of muriate of potash.

"2. Plots 7 and 8, upon which potash was used in combination with nitrogen and phosphoric acid, respectively, also gave profitable crops, the net gains being \$23.16 in one case and \$24.48 in the other. The combination of nitrogen, phosphoric acid and potash (plot 9) called for the largest investment, but yielded the largest net profit, viz., \$47.03, or 110 per cent. of \$42.80, the market value of 2600 lbs. of a complete potato manure.

"The sweet potato crop of 1887, compared with the similar crop upon the same plots in 1883, shows the gain or loss of fertility of the plots due to a continued use of manure and fertilizers.

"Wherever potash was used, the improvement in the value of the crop varies from 8 per cent. to 107 per cent. In all cases where potash was excluded the decrease in the value of the second potato crop is serious, ranging from 36 to 63 per cent.



"The results from the use of muriate of potash are of special interest; the crop grown with its aid in 1883 was worth \$64.58 per acre; a similar crop grown upon the same plot in 1887 was worth \$87.45 per acre; the improvement in the land consequently may be placed at 35 per cent.

"The cost of this improvement may be estimated as follows: The total value of all crops grown upon this soil during the past six years amounts to \$197.22. An equal area of unmanured land in the same crops during the same period yielded products worth \$90.51; the increase caused by the use of \$19.50 worth of muriate of potash is \$106.71, leaving a balance of \$87.21 to represent the net returns from an acre dressed with this salt. The improvement of 35 per cent. in the crop-producing power of this plot, has therefore been gained without sacrifices of any kind."

General experience: "To the results of the experiment is added the experience of practical farmers, secured from answers to a circular letter inquiring about the effect of potash upon their crops. This form was sent to a few farmers in each county of the State. Answers have been received from twenty-three, representing ten counties; of these seventeen, representing nine counties, reported the profitable and continued use of either muriate of potash, kainit or unleached wood ashes as a fertilizer for potatoes, corn, grass and fruit. Twelve farmers, representing eight counties, favored the use of muriate of potash, while five having used both muriate and kainit, were satisfied that kainit gave the largest returns for the money invested. The weight used per acre ranged for corn from 50 to 200 lbs. of muriate, and from 300 to 500 lbs. of kainit. The crops reported as being especially benefited were corn, potatoes, fruit, clover and oats. Without exception, the use of potash, either alone, or as an adjunct to farm manures, was regarded as highly satisfactory and economical.

"These results, gained from experiment, and confirmed by practice, while only positive for the farms and crops represented, should have a significance for those farmers who have not tested their soils, because they not only demonstrate that soils, differing widely both in formation and previous treatment, respond profitably to applications of potash alone, but also indicate a general lack of potash in the soils of the State, and consequently point out the importance of soil tests by the farmers themselves; for when maximum crops can be secured by the application of potash alone, it is poor economy to apply

complete fertilizers, costing \$40 per ton, in which \$5 represents the value of the potash."

1893.

By THEO. BROWN, SWEDSBORO, GLOUCESTER CO. Sixth Annual Report.

"The experiment this year shows that not only can sweet potatoes be raised by chemical manures alone, but that the increased yield was sufficient to pay a considerable profit.

"The average net gain for 1892-1893 from the use of chemicals is \$22.65, while that from the horse manure has been hardly sufficient to pay the cost of the manure."

## RICE.

NORTH CAROLINA, 1882.

By C. W. DABNEY, DIRECTOR. Annual Report.

"A few isolated trials encourage us to hope that in kaintit we have an agent to assist in the restoration of our worn-out rice lands."

## RYE.

MASSACHUSETTS (State Station), 1891.

STATION EXPERIMENT BY C. A. GOESSMANN, DIRECTOR. Annual Report, 1891.

"The most conspicuous result of the field experiment, carried on upon field A during the years 1884 to 1888, consists in the very striking illustration of a marked deficiency of the soil on trial of available potash, as compared with the other essential articles of plant food."

1895.

By WILLIAM P. BROOKS, AGRICULTURIST. Thirty-third Annual Report.

"This crop is most largely increased by muriate of potash and nitrate of soda, but responds much less freely to an application of fertilizers than corn."

RHODE ISLAND, 1890.

By C. O. FLAGG, DIRECTOR. Third Annual Report.

"Potash increased the yield of grain two or three fold."

## SORGHUM.

NEW JERSEY, 1883.

The experiments of 1881 and 1882 were repeated in 1883.

"Potash alone develops more sugar per acre than any other single material.

"The conclusion, then, from this experiment is, that potash was the element which influenced sugar production in sorghum most favorably."



1888.  
By E. B. VOORHEES, Bulletin No. 54. Summary of field experiments for the years 1881, 1882, 1883, 1884 and 1885.

"Each experiment was made upon sod ground on widely different sections of the College Farm."

Yield of Sorghum: "1. Without exception, under all the varying conditions of soil and seasons, muriate of potash used alone has noticeably increased the total weight of the sorghum crop."

"2. Without exception, this increase each year has exceeded that caused by phosphoric acid and nitrogen used either alone, or in combination with each other."

Yield of sugar: "1. Without exception, this increase has exceeded that caused by a combination of nitrogen, phosphoric acid and potash."

"The results secured from similar experiments on sorghum, at Rio Grande, Cape May County, during 1885, 1886 and 1887, corroborate the above statements in nearly every particular, and admit of the conclusion that potash is the element which exerts the most marked influence upon the yield of sorghum and upon the production of sugar."

## STRAWBERRIES.

GEORGIA, 1891.

PROF. G. SPETH, HORTICULTURIST OF THE STATION, in Bulletin No. 15, recommends a fertilizer for strawberries being composed of acid phosphate, muriate of potash and cotton-seed meal, which would show in an analysis 2.7 per cent. phosphoric acid, 15.5 per cent. potash and 4.98 per cent. ammonia. This might be supplemented early in spring with 200 lbs. nitrate of soda per acre.

## SUGAR BEETS.

NEBRASKA, 1893.

By H. H. NICHOLSON AND T. L. LYON. Bulletin No. 27. The largest yield was obtained from the use of kainit, amounting to 5370 lbs. of sugar per acre. The next largest was from a mixture of bone dust, kainit and nitrate of soda, amounting to 5067 lbs. of sugar per acre.

"The application of bone dust and kainit increases the sugar content and yield of beets."

1894.

By H. H. NICHOLSON AND E. E. NICHOLSON. Bulletin No. 36. The experiments on the sugar beets reported for 1892 were continued and as before, the best results were obtained from the use of kainit, which gave a yield of 3640 lbs. of sugar per acre.



**SUGAR CANE.****LOUISIANA, 1886.**

EXPERIMENT BY W. C. STUBBS, DIRECTOR. Bulletin No. 14.

"An inspection of our results will show that potash has increased the tonnage to a marked extent, in one instance as much as  $8\frac{1}{2}$  tons over meal and phosphate.

"For the present it suffices to know that potassic manures used in large quantities on these black lands did produce an increased tonnage.

**MISSISSIPPI, 1889.**

BY S. M. TRACY, DIRECTOR. Annual Report.

"The largest amount of total solids in the juice was from plot 7, which received 100 lbs. of muriate of potash."

**TIMOTHY.****KENTUCKY, 1889.**

EXPERIMENT BY M. A. SCOVELL, DIRECTOR. Bulletin No. 23.

Soil—Blue grass, wet land.

"The potash fertilizers gave much the better results on timothy."

**MASSACHUSETTS (Hatch Station,) 1892.**

Bulletin No. 18, April, 1892. Special Corn Fertilizer vs. Fertilizer Rich in Potash:

"The results were similar to those obtained with corn. . . . The average (of the special corn fertilizers) costing within four cents of \$3 more per acre, gave a crop worth at least (at current prices for common millet) \$6.38 less per acre than the fertilizer rich in potash, a net advantage in favor of the latter fertilizer of \$9.34. This result affords further evidence, therefore, of the correctness of my conclusion in regard to fertilizers. They are, undoubtedly, as a rule, too poor in potash."

**TOBACCO.****KENTUCKY, 1889.**

EXPERIMENT BY M. A. SCOVELL, DIRECTOR. Bulletin No. 28. Experiments were made to determine the amount of yield from the use of fertilizers. The increase of yield was very marked and seems most favorable from the combination of potash and nitrogen. The clear profit derived from the use of fertilizers amounted to \$100.95 on the field treated with sulphate of potash and nitrate of soda. The complete mixture yielded a profit of \$107.70.

Conclusions: "Potash and nitrogen in combination seem to be required to produce the best results."

"There is a handsome profit by using fertilizers in the best combinations."

### 1893.

EXPERIMENT ON TOBACCO, CORN AND POTATOES. Bulletin No. 45.

General summary: "Results obtained in 1892 are almost identical with those of the last four years, that is:

"1. Wherever potash was one of the ingredients of the fertilizer used, whether on corn, tobacco or potatoes, there was an increased yield.

"2. That where phosphoric acid or nitrogen or both were used without potash, there was scarcely any increase in yield over those plots receiving no fertilizer.

"3. That there was a profit in the use of fertilizer in every instance where potash was one of the ingredients."

By A. M. PETER. Bulletin No. 46.

"For lack of space we can only call attention here to the very remarkable agreement of these results for a series of years in showing the benefit derived from a liberal use of potash fertilizers on the soil of the Station farm. In nearly every instance potash produced a very marked increase in the yield; and, in some cases, it was the most profitable fertilizer used. The use of potash and nitrogen, or of potash, nitrogen and phosphoric acid together, often produced a still greater yield, but the profit was often taken up in the additional cost of the nitrogen, which is the most expensive constituent of fertilizers. A very conspicuous exception to the above statement was proven in the case of tobacco, where the greatest profit was obtained from the use of potash and nitrogen together. The tobacco crop requires a great deal of both of these, but a comparatively small amount of phosphoric acid."

### MARYLAND, 1894.

By H. J. PATTERSON, CHEMIST. Bulletin No. 26.

Experiments were made by the Station in the principal tobacco districts of the State. Regarding the effect of potash salts upon the burning quality, it was found that "sulphate of potash produced a better burning tobacco than any other of the potash salts."

"High grade sulphate of potash is the best source of potash."

### NORTH CAROLINA, 1893.

By R. P. McANALLY, SAXON, ROCKINGHAM CO. Bulletin No. 89.

Soil—Dark gray sandy land, newly cleaned. This experiment was

a soil test, combined with test to ascertain the best form and amount of potash to use. The highest net gain, amounting to \$138.07, came from a combination of cotton-seed meal with muriate of potash, producing 237 lbs. of tobacco per acre, against 87 lbs. on the unmanured plots. Single elements alone produced also a good increase, of which potash produced the most.

"In the above discussion, those plots on which potassium chloride was used have been shown to have excelled all others in total product in net cash value, and in total cash value, save that the heaviest application of kainit balanced the lowest of potassium chloride in total cash value, and stands next to it in net result; while the lowest application of potassium sulphate resulted in giving the highest price per pound."

#### PENNSYLVANIA, 1893.

REPORT of the Pennsylvania State College for the year 1893, p. 83.

"The double carbonate of potash and magnesia slightly surpassed the sulphate of potash, the effect being most noticeable at Rocky Spring."

1894.

By WM. FREAR AND E. J. HALEY. Bulletin No. 30. Experiments were begun in 1893 and continued in 1894, from which the following conclusions were drawn:

"The tobacco grown with the use of a fertilizer composed of dissolved bone black, double carbonate of potash and magnesia, and cotton-seed meal gave especially large leaves of highly desirable texture; next to these came leaves grown with a fertilizer composed of dissolved bone black, sulphate of potash, cotton-seed meal, and sulphate of ammonia. Pending full report, these fertilizers are especially commended for use."

### TOMATOES.

DELAWARE, 1890.

By J. HEYD, NEAR FULTON, KENT Co. Bulletin No. 11.

"Nitrate of soda is regarded as a specific for this plant. This has been demonstrated several times. Mr. Heyd's work, however, shows that exceptions to this rule may be expected. Neither alone or in combination with phosphoric acid and potash did the nitrate prove that it causes an increase sufficient to pay for its purchase and use.

"If a profit results from any application, it must be credited to the mixture of phosphoric acid and potash. At \$6 per ton, of tomatoes,



the amount of said increase would amount to \$15; the cost of the application would approximate one-third of said sum.

"The sweet potato tests demonstrate that muriate of potash can be used with average profit of eight to one."

**GEORGIA, 1890.**

By R. J. REDDING, DIRECTOR. Bulletin No. 11.

"The results indicate that mixed minerals with larger rations of nitrogen are productive of the largest yield, and greatest earliness.

"The effect of nitrogen depends upon the presence of the mineral elements—phosphate and potash."

**MARYLAND, 1889.**

By W. H. BISHOP, HORTICULTURIST. Annual Report. Soil—Clayey loam mixed with gravel.

"Thus there are indications from this experiment that the regulating ingredients in a fertilizer for tomatoes on this soil are nitrogen and potash, while phosphoric acid has less effect."

By H. J. PATTERSON, CHEMIST. Annual Report. The effect of fertilizers on the composition.

The results indicate: "That potash has the effect of producing a fruit with more dry substance, accompanied by a slight decrease in the sugar and an increase in the acid. This, when considered with the increase of the yield, is favorable to the use of potash."

**1890.**

By THE HORTICULTURIST AND CHEMIST. Bulletin No. 11.

"Potash appears to increase the crop more than either of the other elements of plant-food, and nitrogen stood next in this respect. . . . Nitrate of soda and muriate of potash can be recommended as a special fertilizer for the tomato."

SUMMARY BY H. E. ALVORD, DIRECTOR.

"Potash alone as muriate gave good results; better than some mixtures.

"Nitrate and muriate of potash can be recommended as special fertilizers for the tomato.

"The vines and roots of the tomato are very rich in potash."

**1891.**

Annual Report for 1891, page 411.

"Plots 3 and 9 have equal quantities of phosphoric acid, and the latter has potash also. This addition of potash appears to have increased the crop nearly 50 per cent. in 1890, and to have more than doubled it in 1891."

## EXPERIMENT FARM AT SOUTHERN PINES, NORTH CAROLINA.



VIEW OF THE EXPERIMENT FARM AT SOUTHERN PINES. NORTH CAROLINA,  
VEGETABLE DEPARTMENT.

The above illustration shows a portion of the vegetable department of the Experimental Farm of the North Carolina State Horticultural Society at Southern Pines in that State. This farm is being conducted by the North Carolina Horticultural Society in co-operation with the North Carolina Experiment Station and its object is to ascertain the relative proportions of the three principal fertilizer ingredients, Potash, Phosphoric Acid and Nitrogen, needed by various crops for their best development.

This enterprise is of much importance to all American farmers since it is the first attempt in this country to study the problem of proper plant nutrition on such an extensive scale. The experiments conducted here are after the pattern of the celebrated experiments of Rothamsted in England, and results forthcoming are being watched with the greatest interest by agricultural investigators.

**MISSISSIPPI, 1893.**

**TOMATO BLIGHT.** Sixth Annual Report, 1893, page 53. A line of experiments brought out the fact that kainit is an efficient remedy against this destructive disease.

"With these facts in mind, it is evident that neither the lime, tobacco nor plaster had any effect on the blight. Plots 8 and 9, however, treated with a heavy dressing of kainit, show a decided falling off in the number of blighted plants, there being only 33 for one and 42 for the other, while the neighboring two plots to the east show 93 plants each and to the west 58 and 72 respectively. This difference of over 50 per cent. must be credited to the effect of the kainit."

**NEW JERSEY, 1889.**

By C. M. HOUSSELL, DUNHAM'S CORNERS, MIDDLESEX CO. Tenth Annual Report. Soil—Sandy loam.

Consideration of yield: "Fifteen thousand acres were devoted to raising tomatoes in the State. The crop is worth more than one million dollars; it ranks even with wheat, above rye and buckwheat. Nitrate of soda is very effective; its action is largely dependent upon the application and presence of phosphoric acid and potash.

"Whatever previous treatment of the soil or the yield, phosphoric acid and potash should be added in sufficient quantities."

**TURNIPS.****ALABAMA, 1888.**

By J. S. NEWMAN, DIRECTOR AND AGRICULTURIST. Bulletin No. 3.

"Kainit gave a larger yield than any other single substance. It will be observed also that the application of the same number of pounds of kainit and cotton-seed hull ashes resulted in favor of the former, though the cotton-seed hull ashes contained an average of about twice the per cent. of potash."

**VEGETABLES.****MASSACHUSETTS, 1895.**

By CHAS. A. GOESSMANN, CHEMIST. Thirty-third Annual Report.

"From our observations, extending over three years, we arrived at the following conclusions:

"Potash in the form of sulphate has given the most satisfactory results, as compared with muriate, in the case of potatoes, tomatoes, lettuce and spinach, and with onions during the present season."

Conclusions: "1. Sulphate of potash, in connection with nitrate of soda (plot 5) has given in every case but one the best results.



**WHEAT.****KENTUCKY, 1890.**

EXPERIMENT BY ANDERSON JEFFERIES, GLENDALE, HARDIN Co. Bulletin No. 30.

"This indicates that fertilizer, rich in potash, would be best on Mr. Jefferies' land "

**NEW JERSEY, 1882.**

By W. A. STYLES, DECKERTOWN, SUSSEX Co. Bulletin No. 26.

"The highest yield came from barn-yard manure and complete mixture, but by no means the highest profit. The highest profit resulted from the single application of potash."

**VIRGINIA, 1892.**

By D. O. NOURSE, AGRICULTURIST. Bulletin No. 21.

"Dealing with the three elements in combination, we find that if the potash is reduced one-half, the yield is also reduced; while if increased one-half, the yield also shows an increase. This only when in combination with the other elements."

**POTASH AS INSECTICIDE AND FUNGICIDE.****ALABAMA, 1892.**

LEAF BLIGHT OF COTTON, BY G. F. ATKINSON. Biological Bulletin No. 36. Yellow leaf blight of cotton is very destructive, especially in some years. It is due likely to both improper nutrition and unfavorable physical condition of the soil. Prof. Atkinson's experiments show that by the use of kainit, leaf blight is largely, if not entirely prevented, and the yield of cotton increased. This is corroborated by many farmers.

LEAF BLIGHT EXPERIMENTS. 1. At Hope Hull, on the farm of A. H. Clark. Soil—Black loam.

"There can be no doubt as to the effect of kainit, as my former experience is the same as that of this year, but I think to thoroughly prevent the disease, it would require not less than 500 or 600 lbs. per acre. (Kainit.)"

2. Experiments at the Station Farm, Auburn:

"In all of these plots it was easy to see by comparison with the others, that the entire or partial prevention of the disease was due to the kainit.

KAINIT CURES COTTON BLIGHT.



WITHOUT KAINIT.

WITH KAINIT.

RESULTS OBTAINED AT THE ALABAMA EXPERIMENT STATION.

"The yield of kainit plots is increased from 70 per cent. to 100 per cent. above that where no fertilizer was used, and an average of 40 per cent. increase over that of any other fertilizer or combination, without the kainit used.

"During the latter part of September, I photographed plots 4 and 5. The result is reproduced in plate 1.

"These experiments indicate then, that with such a season as the past one, and where the other nutritive matters are present, kainit not only tends to prevent the disease, but also increases the yield."

YELLOW LEAF BLIGHT OF COTTON, BY G. F. ATKINSON. Bulletin No.

41. Mention is made of a field of cotton, upon which a heavy dose of fertilizer was used without kainit, and which was badly affected by blight. Prof. Atkinson, in regard to this field, says:

"Had 200 lbs. to 300 lbs. per acre kainit been applied at the time of the planting, the yield might have been nearly doubled."

Continuation of experiments as reported in Bulletin No. 36 by Mr. A. H. Clark, of Hope Hull:

"September 16th I visited Mr. Clark for the purpose of observing the result of the experiment as presented in the appearance of the foliage of the plant. The result was very marked and plainly indicated the value of kainit in checking the disease. Mr. Clark writes about the experiments as follows: 'It is plain that kainit is a specific for the disease.'"

#### CALIFORNIA, 1880.

By E. W. HILGARD, DIRECTOR. Special Report No. 1 of the College of Agriculture. The attack of phylloxera on the vines produces a diminution of potash and albumen normally contained in the juice. The indication that potash with nitrogenous manures would mitigate the effect on the vines produced by phylloxera has been verified by experience.

"The use of these manures alone has so far improved the condition of the vines as to neutralize the injuries done by the insect, and restore them to their usual productiveness. In all cases where the vines were not too far gone, the condition has been materially improved by the application.

"Potassic manures appear to exert the most decided effect, and fortunately the material which supplies this important substance (kainit) can now be readily obtained in commerce."



## NEW JERSEY, 1890.

By J. B. SMITH, ENTOMOLOGIST. Eleventh Annual Report.

"Potash has heretofore been known only as a fertilizer of very high grade. Experiments made by me during the past year, prove that it has a high value as an insecticide as well. It is effective against plant lice of all kinds, against many naked larvae, and against the wire-worms (*Iulus*) on potatoes. It also kills cabbage maggots. Though I have tested it principally on over-ground insects, yet its greatest field of usefulness is against those pests that live in the ground or around the roots of plants. In localities in which corn is infested by cut-worms, wire-worms, etc., a heavy dressing of potash before planting will destroy all the insects in the ground at that time. For the corn-root louse I have no doubt this will prove a perfect remedy. Where potato ground is infested with the wire worms (*Iulus*) a heavy dressing with kainit will bring relief. Peach orchards that are infested with the black peach aphid on the roots can be renovated by the use of the same substance. On bringing the matter to the attention of farmers, many have been able to recollect that with the use of potash certain insect troubles ceased; but they did not heretofore credit the potash with that result. This item is especially commended to peach-growers in South Jersey. The kainit is preferable to the muriate as an insecticide."

By J. B. SMITH, ENTOMOLOGIST. Bulletin No. 75.

"According to the experience of many farmers, potash salts are very effective as insecticides, destroying grubs and cut worms, scales on peach trees, cabbage maggots, plant lice and corn-root louse. By experiment it was shown that potash salts, preferably kainit were very effective in killing insects."

ROSE CHAFER, USE OF KAINIT. By J. B. SMITH, ENTOMOLOGIST. Bulletin No. 82. Suggestions for practice:

"Prevent the breeding of the insects on your own land. Either late in the fall or early in the spring, land should be plowed and top-dressed with kainit."

## 1891.

CUT-WORMS, WIRE-WORMS, ROOT-LICE. By J. B. SMITH, ENTOMOLOGIST. Bulletin No. 85.

"Potash is a necessary element of plant-food for corn, and if, in supplying the potash, kainit be used, injury (from wire-worms) will be almost entirely prevented. Muriate of potash is also effective, but less so than kainit. The evidence of all the farmers now using kainit for corn, and with whom I have talked on the subject, is to the one

purpose—since they have used potash salts the corn has been practically exempt from injury by cut-worms or wire-worms. That kainit will kill even true wire-worms (*Elatér Larvæ*) I have proved experimentally.”

“Therefore, I advise the application of kainit as a top-dressing, just as soon as the ground is ready to receive it, and as long as possible before planting.”

“During the season of 1890, I found in a fine peach orchard several trees undoubtedly infested by root-lice. I directed the application of kainit in a trench, and the new foliage was normal.”

“Root-lice are very much more common and infest a greater variety of crops than is generally known, causing a sickly appearance in the plants, for which there is no apparent explanation. One of the prominent fruit and truck growers of South Jersey informed me recently that he always used potash in the form of kainit, not because it was always best for his crops, but because it was always the worst for the insects. This gentleman is one of those that make farming pay.”

Foot Note: “Bulletin No. 33 of the Cornell Station has come into my hands since this bulletin was sent to the printer. In it Prof. Comstock reports poor success in laboratory experiments with kainit as against wire-worms. Space is lacking here to go into details, but I will do so in the Annual Report. That laboratory experiments do not always indicate what will happen in the field the following will show:

“On the Voorhees farm, in Somerset County, a fourteen-acre field was divided into sections, to test kainit and muriate of potash as fertilizers, and a strip of seven rows was left untreated between. The land was known to be badly infested with wire-worms and cut-worms, or grub-worms, more especially one low meadow. In the half treated with kainit the corn came up well and was not molested by insects at all; on the muriate half the injury was much lessened, and in the untreated rows, running the full length of the field, almost the whole was destroyed by insects. The experiment was not made to test insecticide effect, but the results were so apparent that Mr. Voorhees spoke of them at once, and reports that since using kainit he has no further trouble with either wire-worms or cut-worms. This has also been the experience of his neighbors, and of all who have been questioned by me. I therefore again repeat my advice, use kainit wherever practicable.”



1893.

ONION MAGGOTS, BY JOHN B. SMITH, ENTOMOLOGIST. Fourteenth Annual Report, page 441.

"Quite early in the year Mr. Theo. F. Baker, of Bridgeton, wrote that the maggots had suddenly made their appearance in his land in very large numbers, and he asked for suggestions. This was rather a surprise to me, because Mr. Baker had stated positively during the preceding winter that no trace of the onion maggot had been heretofore seen on his land. He repeated this statement and added that he has known the insect from other localities and felt positive that this was the first appearance in his fields. Nor did any of his neighbors seem to have known of it until the present season. The appearance in such numbers, therefore, was a matter of some surprise. Fortunately, the growers of onions in that immediate vicinity were fully alive to the consequence that might result from the increase of the insect, and they at once adopted heroic measures. The entire fields were gone over, row by row, and all plants that showed signs of infection were taken out bodily and afterwards destroyed. Then heavy dressings of kainit were applied, with the result that no further traces of these maggots were seen at any time in the season."

PEAR MIDGE, BY JOHN B. SMITH, ENTOMOLOGIST. Fourteenth Annual Report, page 444.

"At my suggestion, Mr. J. M. White, of New Brunswick, whose orchard became infested last season, applied a very heavy top-dressing of kainit (1000 lbs. per acre) under the infested trees, with the result that this year his orchard was practically free from the midge, while in the neighboring orchard, which was also infested last year, and where no measures of any kind had been taken, every Lawrence pear was destroyed, while many of the Bartletts were also attacked."

PEAR MIDGE, BY JOHN B. SMITH, ENTOMOLOGIST. Fourteenth Annual Report, page 455. Experiments were made to confirm the experience gained in the practice of testing the effect of fertilizers against pear midge.

"From Mr. White's experience, and from the results of the experiments above detailed, I feel justified in concluding that we have in kainit, used rather heavy in fertilizing quantity, an efficient remedy for this insect. The application should be made under the trees as a top-dressing at any time after the midge larvae have left the infested fruit. This means any time in the latter part of June, or somewhat



later in the season. I would recommend the application being made before or immediately after a rain, early in July."

CORN ROOT WEB-WORM, BY JOHN B. SMITH, ENTOMOLOGIST. Fourteenth Annual Report, page 478.

"Direct application of insecticides is not feasible as against these insects; but a very great advantage is everywhere found in favor of those using the mineral fertilizers. . . . I would very strongly advise the application of all the necessary potash in the form of kainit, put on as a top-dressing after the field is prepared for planting, and I would expect to find good results from this practice. Fall plowing and kainit as a top-dressing in spring, will, I feel convinced, destroy by all odds the greatest proportion of the web-worms that may infest the sod, and would also destroy or lessen many other pests which trouble corn during the early part of its life."

#### NORTH CAROLINA, 1882.

BY C. W. DABNEY, DIRECTOR. Fifth Annual Report. Cotton Rust and blight.

"So far as our experiments go, kainit appears to be the most effective agent which has ever been used against those destructive and mysterious diseases of cotton which we call rust and blight."

"It is now the quite general opinion that kainit will prevent the rust in cotton in a great majority of instances; at least, the illustrations of this are very numerous, and there is hardly a dissenting voice. . . . One farmer in an eastern county, where they know all about both complaints mentioned, says: 'Kainit is to rust what quinine is to chills—a specific.'"

#### TEXAS, 1889.

COTTON ROOT ROT, BY L. H. PAMMEL. Second Annual Report.

"Of the fertilizers, kainit has proved most beneficial, 14 plants remaining alive on September 6th. Many correspondents in other cotton States mention kainit as valuable in checking the disease."

#### OREGON, 1892.

BY L. F. WASHBURN, ENTOM. Bulletin No. 18, March, 1892.

"Potash salts are rapidly coming into favor, not only as fertilizers, but also for their insecticidal qualities."

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## COMPOSITION OF FERTILIZER MATERIALS USED AS SOURCES OF PHOSPHORIC ACID.

	NITROGEN %	EQUIVALENT IN AMMONIA %	POTASH (K <sub>2</sub> O) %	AVAILABLE PHOSPHORIC ACID %
So. Carolina Acid Phosphate.....	.....	.....	.....	13 to 14½
Florida Acid Phosphate.....	.....	.....	.....	13 to 16
Tennessee Acid Phosphate.....	.....	.....	.....	15 to 18
Bone Black, dissolved.....	.....	.....	.....	16 to 19
Basic Slag.....	.....	.....	.....	14 to 15
Bone Meal.....	2½ to 4½	3 to 5½	.....	6 to 9
Bone, dissolved.....	2 to 3	2½ to 3½	.....	13 to 15

## COMPOSITION OF FERTILIZER MATERIALS USED AS SOURCES OF NITROGEN.

	NITROGEN %	EQUIVALENT IN AMMONIA %	POTASH (K <sub>2</sub> O) %	PHOSPHORIC ACID (P <sub>2</sub> O <sub>5</sub> ) %
Nitrate of Soda.....	15½ to 16½	18 to 19	.....	.....
Sulphate of Ammonia.....	19 to 20½	22 to 24	.....	.....
Cyanamid.....	15 to 17	18 to 20	.....	.....
Dried Blood (high grade).....	12 to 14	14 to 15	.....	2 to 3
Dried Blood (low grade).....	10 to 11	12 to 13	.....	1½ to 2
Concentrated Tankage.....	12 to 13	13 to 14	.....	1 to 2
Tankage.....	7½ to 9	9 to 11	.....	7 to 9
Bone Tankage.....	5 to 6	6 to 7½	.....	9½ to 15
Dried Fish Scrap.....	9 to 10	11 to 12	.....	5 to 7
Cotton Seed Meal.....	6½ to 7½	7½ to 9	1½ to 2	2 to 3
Castor Pomace.....	5 to 6	6 to 7	1 to 1½	1½ to 2
Tobacco Stems.....	2½ to 3	3 to 3½	2 to 10	½ to 1

## COMPOSITION OF MATERIALS USED AS SOURCES OF POTASH.

	ACTUAL POTASH (K <sub>2</sub> O) PER CENT.	LIME PER CENT.	NITROGEN PER CENT.	AMMONIA PER CENT.	PHOS. ACID TOTAL PER CENT.	CHLORINE PER CENT.
Muriate of Potash.....	50 to 54	.....	.....	.....	.....	45 to 48
Sulphate of Potash (high grade).....	48 to 52	.....	.....	.....	.....	0.3 to 1.5
Sulphate of Potash and Magnesia.....	25 to 28	.....	.....	.....	.....	1.5 to 2.5
Kainit.....	12	.....	.....	.....	.....	30 to 32
Manure Salt, min. 20%.....	20 to 21	.....	.....	.....	.....	.....
Wood Ashes (unleached).....	2 to 8	30 to 35	.....	.....	1 to 2	.....
Wood Ashes (leached).....	1 to 2	35 to 40	.....	.....	1 to 1½	.....
Tobacco Stems.....	5 to 8	3.5	2 to 3	2½ to 3½	.....	.....

# AVERAGE COMPOSITION OF THE MOST IMPORTANT FARM MANURES (U. S. DEPT. AGRICULTURE).

	Nitrogen	Equivalent in Ammonia	Potash (K <sub>2</sub> O)	Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> )
Cow Manure (fresh) .....	0.29%	0.35%	0.10%	0.17%
Horse Manure (fresh) .....	0.44%	0.53%	0.35%	0.17%
Sheep Manure (fresh) .....	0.55%	0.67%	0.15%	0.31%
Hog Manure (fresh) .....	0.60%	0.73%	0.13%	0.41%
Hen Dung (fresh) .....	1.10%	1.34%	0.56%	0.85%
Mixed Stable Manure .....	0.49%	0.60%	0.43%	0.32%

**TABLE GIVING THE AMOUNTS OF FERTILIZER INGREDIENTS  
(Potash, Phosphoric Acid and Nitrogen) CONTAINED IN  
THE CROP FROM ONE ACRE:**

CROP.	YIELD.	STRAW, ETC.	POTASH.	PHOSPHORIC ACID.	NITROGEN
Apples.....	15 tons	.....	60 lbs.	30 lbs.	39 lbs.
Barley.....	30 bu.	2,000 lbs.	51 "	17 "	57 "
Beans.....	30 "	2,700 "	53 "	30 "	75 "
Buckwheat.....	34 "	2,800 "	40 "	14 "	56 "
Cabbage.....	30 tons	.....	270 "	70 "	200 "
Clover, green*.....	.....	15 tons	140 "	40 "	130 "
Clover, dry.....	.....	2 "	88 "	18 "	82 "
Corn.....	70 bu.	6,000 lbs.	55 "	48 "	83 "
Grapes.....	2 tons	7,000 "	39 "	11 "	32 "
Hops.....	600 lbs.	2,700 "	53 "	23 "	84 "
Mixed Hay.....	.....	5,000 "	77 "	18 "	70 "
Oats.....	60 bu.	3,200 "	62 "	22 "	55 "
Onions.....	45,000 lbs.	.....	72 "	37 "	72 "
Pears.....	16 tons	.....	26 "	10 "	32 "
Peas.....	30 bu.	3,000 lbs.	52 "	33 "	108 "
Plums.....	8 tons	.....	40 "	4 "	30 "
Potatoes.....	200 bu.	1,500 lbs.	74 "	21 "	46 "
Rye.....	30 "	4,250 "	45 "	26 "	51 "
Sugar Beets.....	15 tons	6,000 "	143 "	32 "	69 "
Timothy Hay.....	.....	4,000 "	94 "	23 "	89 "
Tobacco.....	1,600 lbs.	1,400 "	200 "	16 "	76 "
Tomatoes.....	10 tons	.....	54 "	20 "	32 "
Turnips.....	700 bu.	5 tons	180 "	52 "	80 "
Wheat.....	35 "	3,000 lbs.	31 "	24 "	59 "

\* Crimson Clover.



## DISTANCES RECOMMENDED FOR PLANTING.

(In planting trees the greater distance should be given on the richer soils)

Apples (standard)	20 to 30 feet each way.
Apples (dwarf)	6 to 10 " " "
Pears (standard)	20 to 25 " " "
Pears (dwarf)	12 to 15 " " "
Quinces	15 " " "
Peaches	18 to 24 " " "
Plums	15 to 20 " " "
Cherries	15 to 20 " " "
Figs	12 to 15 " " "
Japan Persimmons	15 to 20 " " "
Mulberries	20 to 25 " " "
Oranges (Sweet)	20 to 25 " " "
Oranges (Japanese)	12 to 15 " " "
Blackberries	6 by 4
Raspberries	6 by 3
Currants	5 by 3
Gooseberries	5 by 3
Strawberries (Hills)	36x18 inches.
Strawberries (Matted rows)	48x12 "
Grapes	8x8 to 10x12 feet.
Asparagus	4x2 feet.
Rhubarb	4x2 feet.

## NUMBER OF PLANTS PER ACRE AT VARIOUS DISTANCES.

DISTANCE INCHES.	PLANTS	DISTANCE INCHES.	PLANTS	DISTANCE FEET.	PLANTS	DISTANCE FEET.	PLANTS
1 x 1	6 272,640	10 x 48	13,068	4 x 5	2,178	9 x 10	484
1 x 3	2,090,880	15 x 15	27,878	4 x 6	1,815	9 x 11	440
1 x 4	1,568,160	15 x 30	13,939	4 x 7	1,556	9 x 12	403
1 x 5	1,254,528	15 x 36	11,616	5 x 5	1,742	10 x 10	435
2 x 2	1,568,160	18 x 36	9,680	5 x 6	1,452	10 x 12	363
2 x 3	1,045,440	18 x 48	7,260	5 x 7	1,242	10 x 15	290
2 x 4	784,080			5 x 8	1,089	10 x 18	242
2 x 5	627,264	FEET.		5 x 9	968	10 x 20	217
3 x 3	696,960	1 x 1	43,560	6 x 6	1,210	12 x 12	302
3 x 4	522,720	1 x 2	21,780	6 x 7	1,037	12 x 15	242
3 x 5	418,175	1 x 3	14,520	6 x 8	907	12 x 20	181
4 x 4	392,040	1 x 4	10,890	6 x 9	806	15 x 15	193
4 x 5	313,643	1 x 5	8,712	6 x 10	726	15 x 18	161
5 x 5	250,905	2 x 2	10,890	7 x 7	888	15 x 20	145
6 x 6	174,240	2 x 3	7,260	7 x 8	777	18 x 18	134
7 x 7	128,013	2 x 4	5,445	7 x 9	691	18 x 20	121
8 x 8	98,010	2 x 5	4,356	7 x 10	622	18 x 24	100
9 x 9	77,440	3 x 3	4,840	8 x 8	680	20 x 20	108
10 x 10	62,726	3 x 4	3,630	8 x 9	605	20 x 24	90
10 x 20	31,362	3 x 5	2,904	8 x 10	544	20 x 30	72
10 x 24	26,132	3 x 6	2,420	8 x 11	495	30 x 24	60
10 x 30	20,908	3 x 7	2,074	8 x 12	453	30 x 30	48
10 x 36	16,424	4 x 4	2,722	9 x 9	537	30 x 36	40







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